Of Mothers and Managers – The Effect of Videos Depicting Gender Stereotypes on Women and Men in the Security and Privacy Field

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Abstract

Gender imbalances are prevalent in computer science and the security and privacy (S&P) field in particular, giving rise to gender stereotypes. The existence of such stereotypes might elicit the *stereotype threat effect* well-known from research in math settings: mere exposure to stereotypes can decrease the performance in and attitude towards specific fields. In this work, we investigate whether the stereotype threat effect influences women and men in the S&P field. We conducted an online experiment with multiple groups to explore whether videos that depict and counteract gender stereotypes influence S&P attitudes and intentions (RQ1), and (self-assessed) S&P knowledge (RQ2). We find overall little evidence for the stereotype threat effect, but our results show that women in the condition actively counteracting gender stereotypes report a higher interest in preventing hacker access to their devices than women in the stereotype conditions. In addition, we find that men score higher than women in a variety of self-report measures, except for security and privacy concerns. These results indicate that stereotypes might need to be addressed early on to prevent stereotypes from becoming social norms and a self-fulfilling prophecy of gender imbalance in the S&P field.

1 Introduction

Computer science in general and the security and privacy field in particular are among the fields where gender imbalances are the most pronounced [5, 12, 52]. In fact, skills required for computer science are often perceived as incompatible with female gender roles [9]. Luckily, a variety of successful programs are trying to counter that imbalance [11, 19, 57]. Yet, research has shown that the security and privacy field is riddled with negative stereotypes [70].

These stereotypes might elicit in women trying to enter the security and privacy field what is known as stereotype threat. This effect has been well-documented in the field of mathematics [61]: when individuals are exposed to depictions or descriptions of stereotypes that target them, it can affect the objective performance and interest in the respective domain of these individuals. For instance, in [16] exposure to gender stereotypes portraying commercials decreased women's performance in a math test (despite the stereotypes not being math performance-related), while women who saw counter-stereotypic commercials performed as well as men did in the same test. The stereotype threat effect has been shown to affect individuals targeted by a wide variety of stereotypes, such as ethnicity (e.g., [3]) or gender (e.g., [47]).

In this work, we investigate whether stereotypes portrayed in commercials videos can elicit the stereotype threat effect and affect security and privacy (S&P) attitudes, and (self-assessed) S&P knowledge in the same manner as they can in the mathematics context. To that end, we conducted a 4x2-between-subject online randomized controlled trial experiment with $N = 959$ participants. We tested a variety of security and privacy aspects – including security attitude, security behavior intention, technological affinity, and privacy concerns – across four experimental conditions (stereotype women, stereotype men, non-stereotype, control) and across men and women.

Specifically, we investigated the following two research questions:

RQ1: *Do videos that depict gender stereotypes influence S&P attitudes and intentions?*
Women in the non-stereotype condition reported more interest in preventing hackers from getting access to their devices. Men overall scored higher on the measured scales, except for concerns where women scored higher.

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RQ2: *Do videos that depict gender stereotypes influence (self-assessed) S&P knowledge?*
Women in the group with videos depicting women in stereotypical settings reported higher levels of computer security knowledge than women in the other groups. Men performed better in terms of the S&P knowledge metrics than women.

Our paper makes the following contributions:

- We show that the stereotype threat effect does not seem to affect the S&P domain in the same way as in [16], highlighting the need to identify alternative factors influencing gender imbalances in S&P.
- We validate and extend prior work by showing that there exist differences between men and women regarding their S&P attitudes, intentions, (self-assessed) knowledge, and interest.
- We contextualize our findings in the related work and discuss implications for priming studies.

2 Related Work

2.1 Stereotype Threat

Stereotype threat is a psychological phenomenon which inhibits the performance of individuals in real-life situations when they are confronted with descriptions or depictions of negative stereotypes pertaining to the performance of specific groups of people they are part of [54]. Among the first cases where this effect was observed was the performance of women in math tests [61]. Their performance could be manipulated by either telling them that math performance was affected by gender, in which case they performed worse than similarly skilled men, or that it was not affected by gender, in which case they performed similarly to the men [61]. The same difference in performance could be observed when women were just told their performance would be checked in a math test versus them being made aware of the stereotype threat effect [37]. In essence it induces anxiety that impairs short-term academic performance [54]. It has since been shown to impact a wide variety of individuals from various backgrounds that are affected by negative performance stereotypes (e.g, [3, 47, 50, 60]). The effect has been shown to appear as early as elementary and middle school [25, 54].

Effective countermeasures to the stereotype threat effect include explicit communication contradicting the stereotype [48], describing the skill required for a particular task as malleable [3, 25], re-framing it as a challenge [2], or re-framing it as consequence of a specific situation that was possible to overcome (such as difficulties in math after changing from elementary to middle school) [25]. Offering support to affected individuals has also been shown to be an effective counter-measure [11, 19, 57].

The stereotype threat effect and whether it is possible to observe this effect in the security and privacy domain is the main subject of this work.

2.2 Gender Stereotypes in Advertising

Advertisements are strongly biased in terms of gender representation [49]. Men are far more present with more screen time and more voiceovers than women. Women are also still depicted in traditional gender roles, e.g., as housewives, as opposed to men who are depicted as independent or with physical activity. Furthermore, the sexualization of both genders is increasing with a steeper increase in the depictions of women [49], despite the fact that a recent meta-review [36] found sexualized depictions in advertisements has no effect on purchase intention and there is even a small negative effect on brand attitude. In fact, it was found that these portrayals are perceived as not representing contemporary society [28].

Critically, the perpetuation of gender stereotypes can happen early [38] in a person's life and in advertisements indeed increasingly affects children [42, 53, 55]. Stereotypical colors are used to indicate whether a product is meant for girls or boys and toys aimed at girls put a focus on appearance, nurturing, and cooperation while toys aimed at boys put a focus on competition, independence, and physical activity [4, 14]. Due to the pervasive nature of advertisements in our society, these stereotypical depictions have the potential of influencing a wide audience. They have been found to elicit stereotype threats relating to math problems among women [16] and they might shape children's understanding of gender [4, 7] and in turn their interests and behavior [51].

Therefore, advertisement videos represented the ideal choice for our study. If stereotypical depictions in advertisements can influence adults' and children's interest in security and privacy topics this could have detrimental effects on the respective protections people employ.

2.3 Gender Stereotypes in the STEM Field

Research has indicated that some differences between men and women exist in the STEM field in general and in the security and privacy domain in particular. When considering the wider STEM field, it has been found that women are more likely to experience a lack of support [11] and systematic support structures have a positive impact on women staying in their chosen discipline [57]. Whether women choose a major in the STEM field is also influenced by stereotypes. Particularly, nerd-genius stereotypes have been shown to negatively impact women's STEM identity [62]. More specifically for computer science in the STEM field, it was found that traits needed for computer science are perceived as incompatible with female gender roles [9]. When these traits were described as outdated stereotypes, women expressed more interest in computer science.

When looking at gender imbalances in the domain of security and privacy, women seem to have higher confidentiality and integrity concerns than men [41] and while women also feel more negatively about tracking, they are less likely to employ protective actions [13]. Interestingly, there also seems to be some evidence indicating that women might be at higher risk from cyber threats. For instance, they seem to be less aware of data breaches in which their data was involved [46] and more susceptible to phishing [59]. This issue is conflated by a wide array of negative stereotypes towards women in the security and privacy domain [70].

Considering this evidence on gender stereotypes, the reason for performance differences is likely to be connected to stereotype threat as has been well documented in other domains. Therefore, we chose to investigate the stereotype threat effect in the domain of security and privacy.

3 Methodology

We conducted an online experiment following a between-subject design to explore whether videos that depict and counter gender stereotypes influence security and privacy (S&P) attitudes and intentions (RQ1), and (self-assessed) S&P knowledge (RQ2).

3.1 Selection of Videos and Study Conditions

We used videos in our study to elicit gender stereotypes in our participants which we identified in a multi-stepped procedure. As already outlined in section 2, we decided to base our investigation on advertisement videos since it has already been shown that they can elicit the stereotype threat effect [16]. Specifically, we used commercials as treatment (following similar work by Davies et al. [16]), as opposed to text instructions (used by e.g., Johns et al. [37]) since we sought to understand whether real-world commercials have the potential to negatively impact women in the STEM field.

Step 1: Initial Search. To identify suitable videos, we performed a search on the YouTube video streaming platform with search terms informed by the related work: one of either “ad”, “advertisement” or “commercial” combined with one of “baby formula”, “detergent”, “stroller”, “car”, “e-car”, “tech”, “insurance”, “bank”, “smart home”, “stem”, “science”, “space”, “engineering”, and “cosmetics”.

From the videos we found, we decided to choose videos fitting four study conditions. Firstly we chose videos that depicted women in stereotypical situations (*Stereotype women* condition), e.g., as mothers or spouses, akin to the work in [16]. Secondly, we searched for videos that depicted men (but not women) as stereotypical representatives of the engineering and science domains (*Stereotype men* condition). The message to women in this condition might be that men rather than women are typically working there, playing into perceived social norms [9]. Thirdly, we chose videos that used non-stereotypical representations of women (*Non-stereotype* condition). Specifically, we chose videos promoting campaigns for women in STEM and computer science. Since these videos are explicitly created with countering stereotypes in mind, we felt it was the strongest opposite of the two stereotype conditions. Last but not least, we chose neutral videos, as the baseline for our comparison (*Control* condition). Specifically, we chose non-anthropomorphized depictions of animals (e.g., horses running across mountain landscapes)[1]. We selected several videos for each of these conditions. The most suitable two for each condition were selected in a pre-study as outlined below.

Step 2: Pre-Study to Select Most Suitable Videos. To identify the most suitable video for each condition (stereotype, non-stereotype, control), we conducted an online survey as pre-study. The survey had the participants watch several of the candidate videos in a randomized order and for each video rate to what degree the shown video includes several stereotypes. The full questions can be found as an online appendix on GitHub[2]. We recruited $n = 92$ participants off the Prolific platform. They were compensated with \$3.76. The mean duration of the pre-study was 17:15 minutes.

Based on our results we identified two videos for each condition that would be shown in a random order in the main study. Specifically, these videos were:

- **[*Stereotype women* condition]** For the first stereotype condition, we chose two videos that depicted women (but not men) in homemaker settings. The first video depicts women as taking care of babies. The second video depicts a woman in a family setting, preparing food for the family and doing the laundry. These two videos were rated highly by our pre-study participants in terms of stereotypical depictions of women and portrayals of women primarily as parent/spouse, as opposed to neutral/low ratings for the other stereotypes which together with their content made them an ideal choice: *McDonald’s - Stroller moments*[3] and *Tide Laundry Detergent - Muffins*[4].

- **[*Stereotype men* condition]** For the second of our stereotype conditions, we chose videos that depicted men (but not women) in engineering and science settings. The first video depicted men testing a car as engineers. The second one shows many different individuals in a variety of situations, where men are frequently depicted

[1] Note: While not apparent from the search terms, we found enough of these videos, e.g. bank ads made a great source for these.

[2] https://github.com/petermayer/snp-gender-stereotype-threat-priming-study

[3] https://www.youtube.com/watch?v=vkQ2dkqDFd0

[4] https://www.youtube.com/watch?v=l0cAK9ouRXU

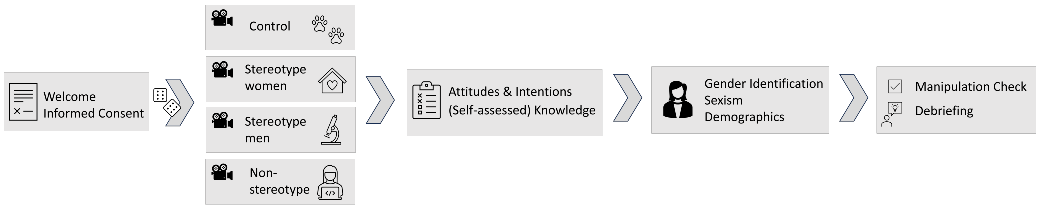

Figure 1: Study procedure.

as scientists or engineers and women in family settings. These two videos were rated highly by our participants in terms of men being portrayed as engineers/scientists, as opposed to low/neutral ratings for the other stereotypes: *Fiat - Fiat 500 S*[5] and *DBS - Live more*[6].

- **[*Non-stereotype* condition]** As non-stereotype condition, we chose videos that depicted women in engineering and computer science settings. The following two campaign ads with *STEM* themes were rated highly by our participants in terms of women being portrayed as engineers/scientists, opposed to low/neutral ratings for the other stereotypes and due to their nature as campaign ads were specifically non-stereotype: *Kode With Klossy x #SheCanSTEM*[7] and *Dare to STEM*[8].
- **[*Control* condition]** For the control condition, we selected the following two videos due to their overall low/neutral ratings for all stereotypes and their content based on non-anthropomorphized depictions of animals: *Lloyds Bank – Epic Journey*[9] and *Mercedes-Benz - Chicken*[10].

We included questions with the same ratings as used in the pre-study questionnaire as manipulation checks in the main study, which confirmed the ratings from the pre-study.

3.2 Study Procedure

The participants were randomly assigned to one of the four video priming conditions. After consenting to the study, they were shown two advertisement videos, which were selected based on their video priming group assignment and directly embedded in the survey.

To investigate RQ1 (S&P Attitudes and Intentions), they were then asked to answer the SA-13 questionnaire [20] to capture their *security attitude*, the SeBIS scale [18] to capture their *security behavioral intention*, the ATI scale [21] to measure their *technological affinity*, the IUIPC-8 questionnaire [27, 44] to capture *privacy concerns*, and 12 statements on a 5-point Likert-like scale taken from Story et al. [63] to assess their *interest in preventing various S&P risk scenarios*, such as hackers gaining device access.

In addition, the participants were asked to complete the following scales and items to investigate RQ2 ((self-assessed) S&P Knowledge): the Technical Knowledge of Privacy Tools Scale [39] consisting of six true/false/I'm not sure items to measure their *technical knowledge of privacy tools*, the OPLIS Technical scale [67], including five multiple choice questions to capture their *technical privacy literacy*, the Internet Know-How Self Report Scale [39] to measure *familiarity with internet tools and concepts*, five items proposed by Sawaya et al. [58] to assess *self-confidence in security knowledge*, three items taken from Bermejo Fernandez et al. [6] to measure *general technical knowledge*, *computer security knowledge*, and *privacy knowledge*, and a self-constructed multiple choice question asking for *S&P skills*.

The participants were then asked to complete the Social Identities and Attitudes Scale (SIAS) [54] to measure their *identification with their respective gender* and the Ambivalent Sexism Inventory (ASI) [23] that captures *sexism*, followed by demographic questions and the option to make a comment to the study. Finally, we asked them to rate the videos they had seen with regards to reflecting general gender stereotypes, and specific gender stereotypes related to the video priming groups, i.e., displaying women and men as engineers/scientists, parent/spouse, and proficient in IT, as a *manipulation check*. After that, we *debriefed* them about the study purpose and explained that the videos they had seen might have contained inappropriate stereotypes, thanked them again for their participation, and redirected them to Prolific. Two attention check questions were included in the study. The final survey can be found as an online appendix on GitHub[11].

On average, it took 16:07 minutes (SD=5:17, Med=17:10) to finish the study. The study was pilot tested with 12 participants recruited via Prolific, who voiced no concerns or needs for adjustments.

3.3 Data Analysis

We conducted a set of one-way ANOVAs to compare S&P attitudes and intentions between the four video priming groups

[5] https://www.youtube.com/watch?v=3YBhftZSlbM
[6] https://www.youtube.com/watch?v=BJurmEJ6dNk
[7] https://www.youtube.com/watch?v=WE1r0vY95fU
[8] https://www.youtube.com/watch?v=0o9DeumoTkw
[9] https://www.youtube.com/watch?v=Rkz6X5VrRBU
[10] https://www.youtube.com/watch?v=nLwML2PagbY
[11] https://github.com/petermayer/snp-gender-stereotype-threat-priming-study

Table 1: Study participants' demographics.

	Women	Men
Age		
18-25	10.8%	11.8%
26-35	25.8%	35.9%
36-45	20.4%	24.8%
46-55	18.7%	15.4%
56-65	15.7%	9.4%
66-75	7.7%	2.6%
>76	0.9%	0.2%
Education		
High School Diploma	34.2%	32.9%
Bachelor‘s Degree	40.2%	41.7%
Master‘s Degree	12.9%	17.1%
Ph.D. or higher	1.9%	3.0%
Other	10.3%	5.3%
Prefer not to say	0.4%	/
Occupation		
Employed	55.1%	70.3%
Self-employed	13.8%	10.3%
Unemployed	5.8%	8.3%
Student	4.1%	5.1%
Retired	9.5%	3.8%
Homemaker	8.6%	1.1%
Other	2.8%	1.1%
Prefer not to say	0.4%	/
IT Experience		
Yes	19.1%	43.2%
No	80.9%	55.3%
Prefer not to say	0.2%	1.5%
	M (SD)	*M (SD)*
Hostile Sexism	2.74 (0.77)	3.07 (0.87)
Benevolent Sexism	3.12 (0.81)	3.25 (0.80)
Gender Identification	4.85 (1.32)	4.42 (1.41)

(RQ1) and unpaired t-tests to compare S&P attitudes and intentions between women and men, since these were measured with validated scales and met all assumptions for parametric testing. In case that homogeneity of variances was not given, we used Welch's ANOVA and Welch's t-test instead. Yet, interest in preventing S&P risk scenarios was only captured with single items and thus analyzed with the non-parametric Kruskal-Wallis tests to analyze the effects of the video priming and Wilcoxon rank-sum tests to analyze gender differences, following recommendations for Likert scales and single items in Likert response format [8].

Further, we conducted Kruskal-Wallis tests to analyze the effects of the video priming and Wilcoxon rank-sum tests to analyze gender differences in terms of S&P (self-assessed) knowledge (RQ2), since knowledge test performance is assumed to be ordinal rather than metric, and self-assessed knowledge was measured with single items.

We decided to analyze the video priming effects for women and men separately, as the video priming displaying gender stereotypes can affect both groups differently [16]. For all post-hoc tests, we used Bonferroni-Holm-corrected alpha-levels. Since we have four video priming conditions, the Bonferroni-Holm-corrected alpha-levels are .05, .025, .0167, and .0125 respectively.

We performed an a priori power analysis to calculate the number of participants needed to detect a medium effect ($f = 0.25$; $d = 0.5$) with two-tailed testing ($\beta = 0.95$ and $\alpha = .05$). The analysis indicated a required total sample size of 840 participants for analyzing the parametric data, and a required total sample size of 880 for analyzing the non-parametric data, each including the potential post-hoc tests.

3.4 Recruitment and Participants

We used Prolific to recruit a sample of participants from the U.S., which was balanced regarding sex. Still, we made sure to include participants from all genders using the prescreen function in Prolific. Participants received an hourly wage of $14.38 for their participation. A total of 979 participants completed the questionnaire, of whom 20 were excluded due to failing at least one attention check. Of the remaining 959 participants, 465 identified as women, 468 as men, 14 as non-binary, and one each as trans man, trans women, trans masculine, demigirl, and "born with vagina". We focused our analysis on the participants identifying as either women or men, as we were interested in gender-specific effects and had only sufficient sample sizes for those two gender groups. Our final sample thus included 933 participants, which still well exceeds the required sample size of 880. For the participants' demographics, the reader is referred to Table 1, and to Table 11 in the appendix for a detailed breakdown of the demographics.

3.5 Ethics

The study received IRB approval. All participants provided consent for their participation and for their data being used prior to the study. They were told that they would see advertisement videos embedded in the survey via YouTube and that they therefore also had to consent to YouTube's terms and conditions by taking part in the study. Further, they were informed that they could quit the study at any time, in which case all data collected so far would be deleted. For this, participants could simply close the survey or click on a button labeled "Leave and delete my data". In addition, participants who wished to withdraw from the study after completion could contact us via email or the Prolific platform. At the end of the survey, we included a debriefing text to inform the participants about the research questions, highlighted that the commercials they had seen might have contained stereotypical gender representations, and pointed out that these stereotypical representations do not necessarily correspond to the truth.

3.6 Limitations

Like most experimental studies, our study is subject to several limitations.

First, the video selection relied on the search function on YouTube, which is highly personalized to users through intransparent algorithms [24, 66]. While we tried to minimize the influence of this personalization by searching in fresh browser sessions in private/incognito mode in different browsers, there is no way for us to guarantee that searches performed with, e.g., other browsers and OSes, would not have yielded additional search results. However, we found enough suitable videos that matched our selection criteria (content and stereotype ratings) in our pre-study, which makes us believe that additional search results would not have influenced our findings substantially beyond a negligible extent.

We only included a selection of stereotypes related to traditional roles of women and the traditional dominance of men in the technical field. A broader focus might have yielded further results for other stereotypes. Also, some of the videos were aired several years ago and would perhaps no longer be broadcast in this form today, and the STEM campaign videos are targeted at young women, while our sample included women and men of all ages. Still, the pre-study and the manipulation check confirmed that the videos successfully transferred the intended stereotypes and counter-stereotypes as needed to explore our research questions.

Second, we used Prolific for recruitment, which has been found generally representative for the U.S. population with regards to security and privacy experiences, perceptions, and beliefs, but not knowledge and self-reported behavior, particularly in terms of on social media use [1, 65]. As a result, our sample might perform better in the privacy knowledge tests and report security-related or privacy-related actions that may not reflect those of the general U.S. population. In addition, we only considered participants residing in the U.S. to avoid cultural differences in the groups as unintended additional influence besides the video priming. Hence, further research is needed to explore how gender stereotypes affect women and men with varying cultural backgrounds. We further focused our analysis on participants identifying as women or men, as these were the only gender groups with sufficiently large sample sizes for statistical analysis. Still, we acknowledge that there are multiple other gender groups such as non-binary, and highlight the importance of considering participants from those groups in future research, especially with regards to gender stereotypes. Finding ways to recruit participants with other gender roles in sufficient sample sizes and incorporate them in the analyses is an important line of future work.

Third, although we checked how strong our participants identified with their gender, we did not ask about their identification with the depicted gender stereotypes. Yet, participants who identify strongly with the stereotypes presented, may react more strongly to them than participants who identify less with those stereotypes.

Fourth, the videos depicting and counteracting gender stereotypes might have affected women's and men's responses differently, exaggerating or understating existing gender differences. Further, the men and women in our sample reported considerably different levels of IT experience. While these differences might reflect actual gender imbalances in this field, it is also possible that the men in our sample were more and the women less tech-savvy compared to the general U.S. population.

4 Results

4.1 RQ1: S&P Attitudes and Intentions

Figure 2 shows women's and men's security and privacy (S&P) attitudes and intentions across the video priming groups (RQ1). For the detailed test results, the reader is referred to the appendix.

Security Attitude. Across the four video priming groups, women and men both reported on average moderate levels of security attitude (measured with the SA-13 questionnaire [20]). We did not find significant differences between the four video priming groups for women or men.

Security Behavior Intention. On average, women and men in all four video priming groups reported rather high levels of security behavior intention in terms of device securement, password generation, proactive awareness, and updating (measured with the SeBIS scale [18]). The analysis results did not indicate significant differences between the four video priming groups for women and men.

Technological Affinity. On average, women across the four video priming groups reported low to medium levels of technological affinity, whereas men in all four video priming groups reported medium to high levels of technological affinity (measured with the ATI scale [21]). Two one-way ANOVAs did not indicate significant differences between the four video priming groups for women or men.

Privacy Concerns. Both women and men in all four video priming groups reported high levels of privacy concerns (measured with the IUIPC-8 questionnaire [27, 44]). A set of one-way ANOVAs did not indicate significant differences between the four video priming groups for women or men.

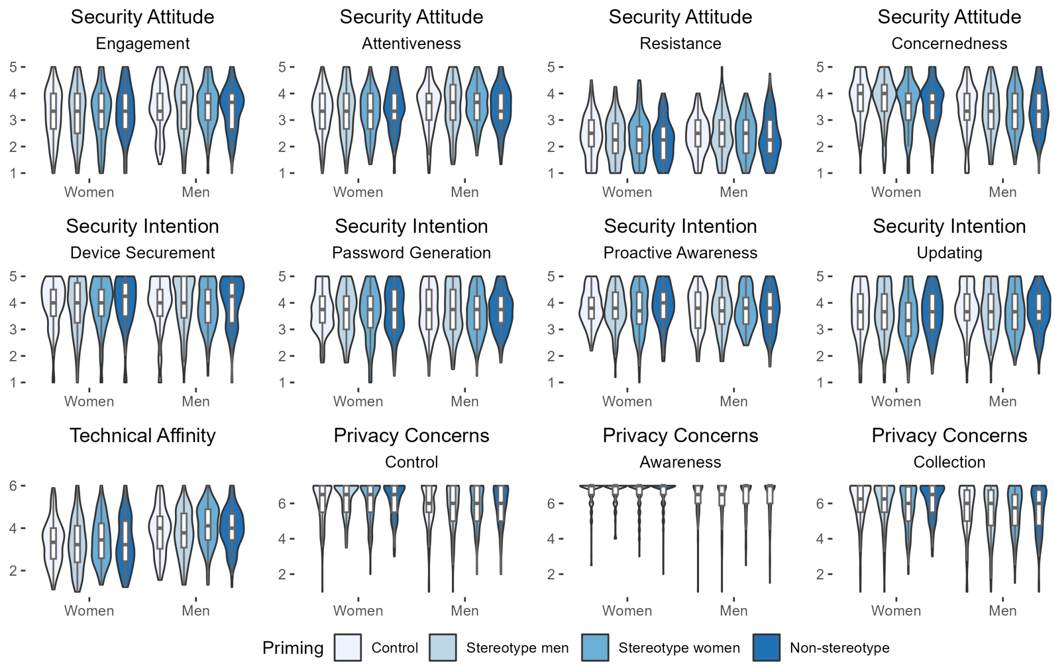

Figure 2: Violin and box plots showing the results for security attitude [20] (1=strongly disagree, 5=strongly agree), security behavioral intention [18] (1=never, 5=always), technological affinity [21] (1=strongly disagree, 6=strongly agree), and privacy concerns [27, 44] (1=strongly disagree, 7=strongly agree). The width of the curves represents the frequency of data points in each region, i.e., the wider the curve gets at a certain value, the more participants have indicated this value. The central line in the box plots marks the median, whereas the boxes indicate the central 50% of the data.

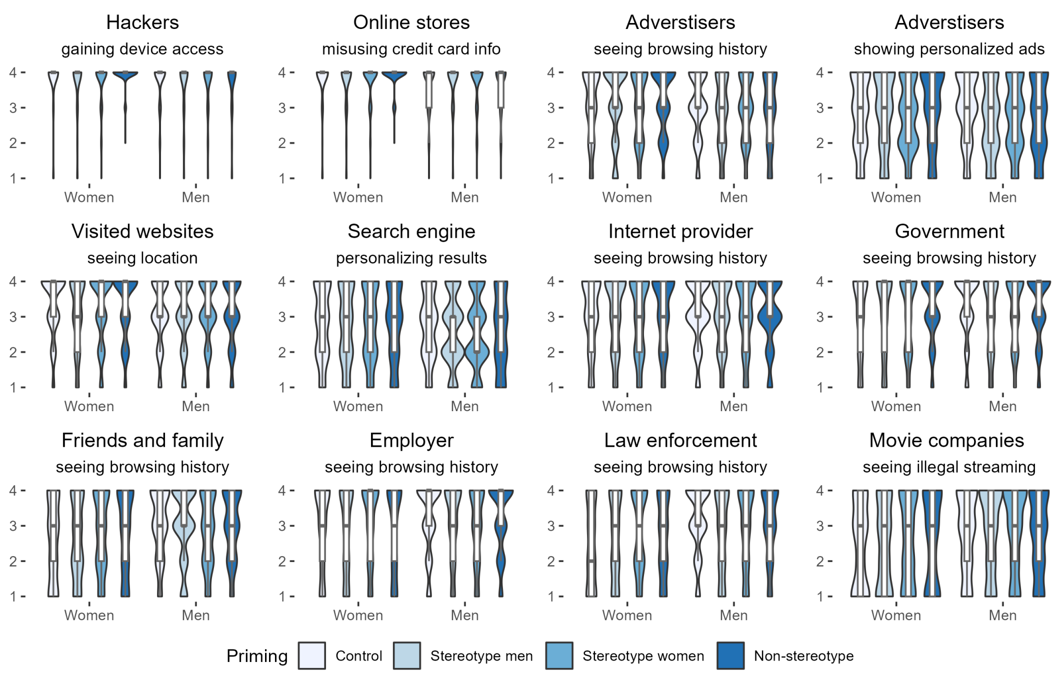

Figure 3: Results for interest in preventing various S&P risk scenarios using 12 statements taken from Story et al. [63] (1=not at all interested, 4=very interested).

Interest in Preventing S&P Risk Scenarios. Figure 3 shows women's and men's interest in preventing various scenarios describing security incidents or privacy infringements (measured with 12 Likert-like items taken from Story et al. [63]). Due to the ordinal scale level of the data, we calculated non-parametric tests (the detailed test results can be found in the appendix).

On average, women and men in all four video priming groups reported a great interest in preventing hacker access to their device, and misuse of their credit card information by online stores. Further, they reported a moderate to great interest in preventing advertisers, law enforcement, the government, their Internet provider, friends and family, and employer seeing their browsing history, advertisers showing personalized ads, websites they visit seeing their physical location, search engines showing personalized results, and movie companies seeing illegal movie streaming.

A Kruskal-Wallis test revealed significant differences in women's interest in preventing hackers from gaining access to their device between the four video priming groups ($\chi^2(3)$=11.696, p=.009, η^2=.019). Pairwise comparisons using Wilcoxon rank-sum tests with Bonferroni-Holm corrections of the alpha-level showed that women in the *Non-stereotype* condition reported significantly higher levels of interest to prevent hacker access to their device than women in the *Stereotype women* condition (Z=-3.008, p=.003, r=.197). Likewise, women in the *Non-stereotype* condition reported significantly higher levels of interest in preventing hacker access to their device than women in the *Stereotype men* condition (Z=-2.988, p=.003, r=.197), both indicating a small effect [10]. We could not replicate these effects for men. A set of further Kruskal-Wallis tests did not show significant differences for the other S&P risk scenarios between the four video priming groups for both women and men.

Summary. Women in the *Non-stereotype* condition reported more interest to prevent hacker access to their devices than women in the two video priming groups displaying gender stereotypes.

4.2 RQ2: Knowledge Test Performance and Self-Assessed Knowledge

Figure 4 shows women's and men's privacy knowledge test performance as well as self-assessed S&P knowledge and skills across the video priming groups (RQ2). The detailed test results can be found in the appendix.

Technical Knowledge of Privacy Tools. On average, women in all four video groups had rather little technical knowledge of privacy tools (measured with the Technical Knowledge of Privacy Tools Scale [39]), while men in all four groups had moderate knowledge. The analysis results did not indicate significant differences between the four video priming groups.

Technical Privacy Literacy. Both women and men in all four video groups scored rather high in terms of technical online privacy literacy (measured with the OPLIS Technical scale [67]). The analysis results did not indicate significant differences between the four video priming groups.

Familiarity with Internet Tools and Concepts. Both women and men in all four video priming groups reported medium levels of familiarity with Internet tools and concepts (measured with the Internet Know-How Self Report Scale [39]). We did not find significant differences between the four video priming groups.

Self-Confidence in Security Knowledge. Both women and men in all four video priming groups reported a medium level of confidence in their security knowledge (measured with 5 items proposed by Sawaya et al. [58]). The analysis results did not indicate significant differences between the four video priming groups.

Self-Assessed Technical Knowledge. Both women and men in all four video priming groups reported medium levels of general technical knowledge, computer security knowledge, and privacy knowledge (measured each with a Likert-item taken from Bermejo Fernandez et al. [6]). The analysis results revealed significant differences in self-assessed computer security knowledge between the four video priming groups for women ($\chi^2(3)$=8.570, p=.036, η^2=.012). Pairwise comparisons using Wilcoxon rank-sum tests with Bonferroni-Holm corrections of the alpha-level showed that participants in the *Stereotype women* condition reported higher levels of computer security knowledge than participants in the *Stereotype men* condition (Z=-2.693, p=.007, r=.176), indicating a small effect [10]. These results could not be replicated for men.

Self-Assessed S&P Skills. Roughly the same number of women described their S&P skills (measured with a self-constructed multiple choice question) as novice or competent and only a very small proportion as expert in all four video priming groups. In all four video groups, most men described their skills as competent, followed by novice and expert. Using Kruskal-Wallis tests, we did not find significant differences between the four video priming groups.

Summary. Women in the *Stereotype women* condition reported higher levels of computer security knowledge than women in the *Stereotype men* condition.

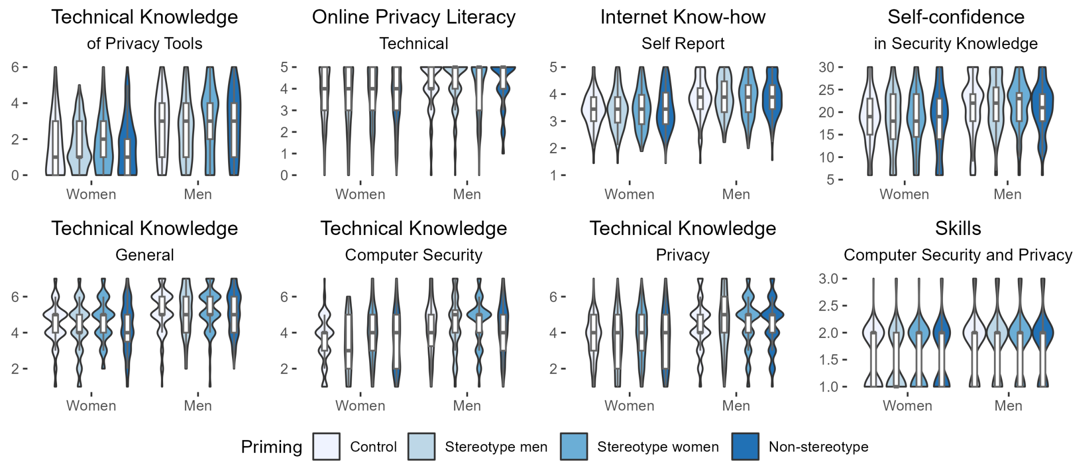

Figure 4: Results for technical knowledge of privacy tools [39] (1=low, 6=high), technical privacy literacy [67] (1=low, 5=high), familiarity with internet tools and concepts [39] (1=I've never heard of this, 5=I know very well how this works), self-confidence in security knowledge [58] (sum of 6 items from 1=strongly disagree to 5=strongly agree), general technical knowledge, computer security knowledge, and privacy knowledge [6] (1=low, 7=high), and S&P skills (1=novice, 2=competent, 3=expert).

4.3 Gender Effects

We further calculated unpaired t-tests (and Welch's t-tests, respectively, in case that homogeneity of variance was not given) and Wilcoxon rank-sum tests to analyze gender differences. For the detailed test results, the reader is referred to the appendix.

S&P Attitudes and Intentions. The results of the unpaired t-tests and Welch's t-tests indicated small significant differences between women and men for all four scales of the SA-13 questionnaire [20] measuring security attitude, with men reporting higher levels of security engagement (t(931)=-3.256, p=.001, d=-0.213), attentiveness (t(931)=-3.289, p=.001, d=-0.215), and resistance (t(931)=-1.969, p=.049, d=-0.129) than women, while women reported higher levels of security concernedness than men (t(931)=5.795, p<.001, d=0.379). Our results did not indicate significant differences between women's and men's security behavior intention as measured with the SeBIS scale [18]. Using Welch's t-tests, we further found significantly higher levels of self-reported technological affinity for men than for women with a medium effect size (t(923.846)=-8.211, p<.001, d=-0.538), and small significant gender differences for all three scales of the IUIPC-8 questionnaire [27, 44] measuring privacy concerns, with women indicating higher levels of control (t(917.367)=4.662, p<.001, d=0.305), awareness (t(863.300)=4.784, p<.001, d=0.313), and collection concerns (t(914.466)=5.009, p<.001, d=0.328) than men.

With regards to the different S&P risk scenarios, a set of Wilcoxon rank-sum tests showed that women reported significantly higher levels of interest than men to prevent hacker access to their device (Z=-3.046, p=002, r=0.100), misuse of credit card information by online stores (Z=-2.992, p=.003, r=0.098), advertisers seeing their browsing history (Z=-2.730, p=.006, r=0.089), visited websites from seeing their location (Z=-2.930, p=.003, r=0.096), and receiving personalized search results based on their browsing history (Z=-2.464, p=.014, r=0.081).

Men, on the other hand, reported significantly higher levels of interest than women in preventing friends and family from seeing their browsing history (Z=-3.231, p=.001, r=0.106), along with law enforcement seeing this browsing history (Z=-3.706, p<.001, r=0.121), and movie companies seeing illegal movie streaming (Z=-3.624, p<.001, r=0.119), with small effect sizes for all gender differences.

Knowledge Test Performance and Self-Assessed Knowledge. Using Wilcoxon rank-sum tests, we found higher levels of technical knowledge of privacy tools (measured with the Technical Knowledge of Privacy Tools Scale [39]) for men than for women with a small to medium effect size (Z=-9.471, p<.001, r=0.310). In addition, we found significantly higher levels of technical online privacy literacy (measured with the OPLIS Technical scale [67]) for men than for women with a small effect size (Z=-6.003, p<.001, r=0.197).

Men also reported significantly higher levels of familiarity with Internet tools and concepts (measured with the Internet Know-How Self Report Scale [39]) than women with a small effect size (Z=-9.039, p<.001, r=0.296). Likewise, men reported slightly higher levels of confidence in their security knowledge (measured with 5 items proposed by Sawaya et al. [58]) than women. This difference was statistically significant with a small effect size (Z=-6.741, p<.001, r=0.221). We further found significantly higher values of self-assessed general technical knowledge for men than for women (Z=-9.009, p<.001, r=0.295), along with higher values of computer security knowledge (Z=-8.141, p<.001, r=0.267), and privacy knowledge (Z=-8.183, p<.001, r=0.268; measured each with a Likert-item taken from Bermejo Fernandez et al. [6]), all with a small effect size. In addition, the analysis results indicated significantly higher levels of self-assessed S&P skills for men than for women with a small effect size (Z=-6.525, p<.001, r=0.214). As IT experience might influence self-assessed S&P skills, we further performed an ordinal regression analysis, which confirmed an effect of IT experience on self-assessed S&P skills. Still, the gender effect persists even if we control for IT experience. The regression results showed that women are 47% less likely to identify themselves as experts compared to men; while a participant who has no IT experience is 71% less likely to identify themselves as expert compared to a participant who has IT experience (both effects are significant with p<.001).

Summary. Men indicated greater levels of security attitude on the scales engagement, attentiveness, and resistance, and greater technological affinity. In comparison, women indicated greater levels of security attitude on the scale concernedness, and greater privacy concerns. Further, men and women were interested in preventing different S&P risk scenarios. There were no gender differences in terms of security behavioral intention. In addition, men performed better in terms of technical privacy tools knowledge and technical privacy literacy, and indicated a greater familiarity, self-confidence, knowledge, and skills with regards to S&P than women.

5 Discussion

We expected the findings of our study in the S&P field to mirror those previously reported for mathematics [16], i.e., that stereotype-laden videos can elicit the stereotype threat effect and consequently influence performance and S&P attitudes. When interpreting our findings, it is important to to consider that there is an essential difference between the prior studies on mathematics and our study: while the mathematics studies were able to objectively measure performance in mathematics tests, our study relies on self-reported data.

Based on these subjective self-reports, we could not find broad evidence for a stereotype threat effect from advertisement and campaign videos in the security and privacy field. The first effect, namely that participating women in the *Non-stereotype* condition reported more interest to prevent hacker access than those in the stereotype conditions, is in line with expectations and might indicate that stereotype threat effects can occur. In contrast, the second effect, namely that participating women in the *Stereotype women* condition reported higher levels of computer security knowledge than participating women in the *Stereotype men* condition, does not seem to relate to the stereotype threat effect. The effect seems to be rather due to problems with eliciting the priming (as discussed in the next section), due to an anomaly in our sampling that lead to this effect, or due to different factors that influenced our participants' gender attitudes across their lifetime.

Several such factors could have played a role and overshadowed the priming in our study. Firstly, if participating women are affected by an unwelcoming or unsupported environment and no support infrastructure is in place to counteract the environmental influences, that might have detrimental effects [11, 57]. Secondly, gender norms might have been adopted by participants due to interpersonal influences in their early adolescence which might in turn have perpetuated stereotypical attitudes far deeper than our study priming could [38]. Concrete results of these differences could be that it is seen more acceptable to not be knowledgeable in the security and privacy field or that different sources for information about security and privacy topics are considered [12]. In any case, further investigations are needed in order to gather further evidence relating to these effects.

Priming Studies. While the effect we found in our data (increased interest in preventing hackers from getting access to devices in the *Non-stereotype* condition) might be an artifact stemming from the sample, it is also possible that the technical priming from the video clips in the *Non-stereotype* condition made the concepts of hacking and device protection more prevalent in the participating women's minds. Participating men who were shown the same video clips did not report increased interest in preventing hacker access to their devices; still, participating men might identify less with the protagonists in the video clips, who are girls and women. Priming studies generally present a number of challenges: For example, the duration of the priming should be chosen with care [71], participants may react with reactance to being influenced [17], especially if the stimuli contain such a clear message as in the *Non-stereotype* condition videos from the #SheCanSTEM and Dare to STEM campaigns. Further, if the content is perceived to be unrealistic, participants' response to a stimulus might be delayed [35]. Also, our priming towards S&P gender stereotypes was rather subtle, as our study did not include a condition with videos showing women performing poorly at STEM tasks. Even using the wide range of search terms described in Section 3.1, we could not find any commercials that fell into this category. Therefore, we could not include this as study condition and had to rely on the *Stereotype men* condition instead which portrayed men but not women as proficient in STEM. The *Stereotype women* condition, on the other hand, depicted women as mothers or spouses. Hence, participating women who are not mothers or in a relationship may not have identified with the women portrayed in the videos. To aid researchers in selecting appropriate priming stimuli, we advocate the creation of databases with validated gender priming content, as has been done in other research domains (e.g., [34]). Finally, priming studies might fail to overcome stereotypes which have been engrained from early childhood on with one-shot stimuli exposure. In the following, we thus discuss alternative paths to overcome gender stereotypes in the S&P context.

Acknowledge the Gender-Imbalance in Today's Ads. The videos we used in our study were not the most recent ads by the respective companies and actually up to 10 years old. This raises the question of whether current advertisement videos are less prone to depict gender stereotypes and still represent suitable objects of study for our experiment. After all, if newer ads do not rely on gender stereotyping, investigating other media might have been the more prudent way to go. However, from analyses of the literature, we know that this is not the case [49]: Women are still depicted as caregivers and men as more independent. This manifests in the continuous need to review and ban advertisements for inappropriate portrayals by authorities, as has been done recently, e.g., for Aptamil in the UK[12] or Honey Birdette in Australia[13]. Thus, the gender imbalance is still there, even with the twist that men are increasingly sexualized and objectified as well (though substantially less than women) [32, 40]. While we explicitly decided against using such banned ads, our results indicate that stereotype threat is currently less of a concern and the issue might lie deeper entrenched in the social norms of societies and the cognitive maps of the children in these societies.

Address Self-Concepts of Children. According to Gottfredson [26], young people start to develop self-concepts that shape their cognitive map of preferences, interests, and aspired competencies early on. Gottfredson [26] and Erdmann et al. [19] posit that gender is one of the most salient cues for selecting role models that serve as direction for these self-concepts, thus, young people mostly lean towards gender-typical options. As a result, gender-atypical options that are not part of their cognitive maps might not even be on a person's radar as they get older. Based on these considerations, Erdmann et al. [19] advocate long-term counseling for young people to break up stereotypical educational choices above short-term interventions that provide too few new experiences to alter a person's cognitive map. They further assume that people can only become role models if they have a close relationship with the addressee, which is usually not the case in short-term interventions.

Hence, it is possible that the campaign videos in our study, being a prime example for short-term interventions, had no significant effect on our participants since they failed to modify the participants' cognitive maps and to provide adequate role models. Long-term interventions such as counseling [19] or mentoring could thus be promising measures for countering stereotypes by pointing out gender-atypical options and support recipients in sticking to their choice, even if this means violating social norms. Campaign videos such as the clips used in our study could then be launched to advertise such long-term programs.

In addition, campaigns should embrace existing role models with whom the addressees already identify. For this, it might also be feasible to inspire communication about S&P topics between less experienced users and people from their social environment who are proficient in these topics, and who could then become role models [22, 43, 56]. Likewise, S&P advocates who serve as role models in a professional context [29, 30, 31, 64] could broach existing stereotypes directly to sensitize their audience to this issue. Still, given the already existing under-representation of women in the S&P field, care has to be taken as not to place additional burdens on those women and thereby intensify unequal job conditions. This could possibly be addressed, e.g., by offering mentoring or orientation programs in which experts from different gender groups participate.

Adopt S&P Content in Curricula. One striking difference between the S&P field and mathematics is that math is a mandatory school subject and so everyone who has undergone the same level of schooling is exposed to roughly the same material (even if some take away more from lessons than others). In multiple countries, this is not the case for S&P subjects, where the acquisition of knowledge and skills is largely dependent on a pre-existing interest in the matter and must be done in one's free time (excluding mandatory workplace S&P programs of questionable quality which set in much later than schooling). Such interests might themselves be driven by social norms and stereotypes [9, 62] and thus any stereotype threat effect might (on average) be overshadowed by actual differences in knowledge and interest resulting from these social influences. Since women have been also found to underestimate their competencies compared to men [15], repeated positive experiences might strengthen girls' and women's self-efficacy. Thus, promising avenues to accustom young people to technical and S&P content regardless of contradicting self-concepts and gender norms include, e.g., integrating such content in existing mandatory school subjects, as mandatory content in training for non-technical professions, or as applications in suitable non-technical degree programs such as economics, social sciences, and law.

Improve Gender Representations at Large Scales. An alternative approach that goes deeper to the root of the problem would be to avoid exposing children to social gender norms and stereotypes. This would require, for example, to transition towards a market with more gender-neutral toys, advertising messages, and content in fictional and factual media such as school textbooks. In addition, gender stereotypes already

[12] https://web.archive.org/web/20200523181620/https://www.standard.co.uk/news/uk/adverts-featuring-harmful-gender-stereotypes-banned-in-uk-a4167306.html

[13] https://web.archive.org/web/20211021190720/https://www.bandt.com.au/aussie/

established in society at large would have to be addressed directly by parents and teachers and exposed as such. To this end, it might be beneficial to address awareness campaigns and counseling programs not only directly to young people or those affected by stereotypes, but also specifically to parents and teachers. A first step towards this is the "#EndGender-Stereotypes" campaign launched by the European Commission in 2023 [68], which aims to challenge widespread gender stereotypes and targets the entire society.

In the U.S., the STEM Opportunities Act [33] seeks to clear the path for people from groups that have been historically underrepresented in the STEM fields, including women, to pursue careers in STEM. Measures include, for example, the organization of workshops that raise awareness for this issue at universities and federal science agencies, and the funding of research work on this topic. The goal thereby should be to have offers available also for marginalized communities and remote areas to reach individuals that might otherwise be excluded from such opportunities.

Future Work. Considering our results, in particular, longitudinal studies investigating when S&P-related social norms are formed seem to be an important line of future work. By that, we echo other work [38]. Such research would shed light on the mechanisms that underlie the prevalent gender imbalances in the S&P field. Based on such studies it would be possible to inform the development and recommendation of interventions tailored to the age when they are most relevant, e.g., campaigns focused on certain age brackets including materials and information for parents that want to prevent such social norms from manifesting in their children's self-concepts.

Additionally, it might be worthwhile to investigate whether it was our method of elicitation that did not have the intended effect (despite our manipulation check). Using different methodologies, e.g., based on direct communication to counter the stereotypes [37], might yield different results, albeit we are skeptical of this.

Ideally, future studies would complement self-reported data with objective metrics. Objective metrics might include knowledge questions as used in testing the effectiveness of security and privacy awareness or education materials (e.g., [45]) or as used in other human factors studies investigating behavior (e.g., [69]). However, in selecting such tasks, care should be taken to not introduce different bias into the study design. For instance multiple different domains in security and privacy would need to be covered and comparable difficulty should be ensured.

6 Conclusion

Inspired by similar research in the field of mathematics [16], we conducted an experimental between-subject study with 959 participants recruited via Prolific to explore whether videos (1) depicting stereotypes associated with women, (2) stereotypes associated with men, (3) non-stereotype depictions, and (4) a control condition showing only non-anthropomorphic content influence women and men in the security and privacy (S&P) field. We find few effects of the videos, but our results show that women who had been exposed to non-stereotype videos reported more interest in preventing hacker access to their devices. In addition, our findings indicate a variety of gender differences, with men reporting higher levels of S&P intentions, and knowledge, while women report higher levels of S&P concern. Based on our findings, we derive several implications for addressing gender stereotypes and social norms, such as implementing long-term interventions (e.g., counseling or mentoring) that target children, young adults, but also parents and teachers, emphasizing familiar people as S&P role models, and exposing students to gender-atypical content via S&P curricula.

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Appendix

Table 2: ANOVA results comparing security attitude (SA-13 [20]), technological affinity (ATI [21]), privacy concerns (IUIPC-8 [27, 44]), and security behavior intention (SeBIS [18]) (DV) between the different priming groups (IV) for women. In cases where homogeneity of variance was not given, Welch's ANOVA was calculated.

	df	F-value	Sig.	*Control* M	SD	*Stereotype men* M	SD	*Stereotype women* M	SD	*Non-stereotype* M	SD
SA13_Engagement	3, 461	0.304	.823	3.24	0.95	3.23	1.01	3.20	0.98	3.32	0.92
SA13_Attentiveness	3, 461	1.413	.238	3.29	0.83	3.32	0.96	3.25	0.81	3.47	0.87
SA13_Resistance	3, 461	0.793	.498	2.38	0.81	2.32	0.80	2.35	0.82	2.22	0.77
SA13_Concernedness	3, 461	2.169	.091	3.78	0.82	3.75	0.87	3.55	0.91	3.58	0.81
SEBIS_DeviceSecurement	3, 461	0.445	.721	3.92	0.88	3.83	0.98	3.92	0.92	3.97	0.94
SEBIS_Updating	3, 461	1.570	.196	3.66	0.96	3.63	0.94	3.43	0.90	3.63	0.83
SEBIS_PasswordGeneration	3, 461	0.787	.501	3.73	0.80	3.65	0.86	3.58	0.95	3.72	0.85
SEBIS_ProactiveAwareness	3, 255.302	0.824	.481	3.83	0.68	3.77	0.75	3.73	0.87	3.87	0.76
ATI_Overall	3, 461	0.655	.580	3.34	1.04	3.25	1.19	3.45	1.05	3.33	1.18
IUIPC_Control	3, 461	0.915	.434	6.09	1.13	6.30	0.91	6.12	1.09	6.20	0.97
IUIPC_Awareness	3, 461	0.320	.811	6.53	0.89	6.57	0.77	6.49	0.86	6.58	0.80
IUIPC_Collection	3, 461	2.018	.111	6.04	1.17	5.99	1.20	5.79	1.17	6.14	0.95

Table 3: ANOVA results comparing security attitude (SA-13 [20]), technological affinity (ATI [21]), privacy concerns (IUIPC-8 [27, 44]), and security behavior intention (SeBIS [18]) (DV) between the different priming groups (IV) for men. In cases where homogeneity of variance was not given, Welch's ANOVA was calculated.

	df	F-value	Sig.	*Control* M	SD	*Stereotype men* M	SD	*Stereotype women* M	SD	*Non-stereotype* M	SD
SA13_Engagement	3, 257.066	0.228	.877	3.44	0.91	3.45	1.00	3.49	0.83	3.40	0.83
SA13_Attentiveness	3, 256.540	0.774	.510	3.48	0.84	3.51	0.94	3.60	0.71	3.46	0.78
SA13_Resistance	3, 578	0.695	.555	2.40	0.71	2.51	0.84	2.39	0.74	2.38	0.84
SA13_Concernedness	3, 578	0.162	.922	3.37	0.94	3.29	0.89	3.33	0.85	3.35	0.83
SEBIS_DeviceSecurement	3, 578	0.665	.574	3.93	0.96	3.98	0.96	3.84	0.83	3.99	0.90
SEBIS_Updating	3, 578	0.306	.821	3.75	0.86	3.69	0.88	3.64	0.84	3.70	0.78
SEBIS_PasswordGeneration	3, 256.828	0.368	.776	3.70	0.86	3.68	0.91	3.59	0.81	3.68	0.72
SEBIS_ProactiveAwareness	3, 578	0.241	.868	3.74	0.79	3.68	0.81	3.76	0.69	3.70	0.78
ATI_Overall	3, 578	2.549	.055	3.86	1.09	3.75	1.08	4.10	0.96	3.97	0.94
IUIPC_Control	3, 578	0.468	.705	5.87	1.21	5.74	1.24	5.83	1.09	5.91	1.13
IUIPC_Awareness	3, 578	0.245	.865	6.26	1.08	6.16	1.16	6.28	1.07	6.23	1.14
IUIPC_Collection	3, 578	0.539	.656	5.71	1.32	5.50	1.39	5.55	1.23	5.60	1.27

Table 4: Kruskal-Wallis test results comparing interest to prevent various S&P risk scenarios (DV) between the different priming groups (IV) for women.

	df	H-value	Sig.	*Control* M_{rank}	*Stereotype men* M_{rank}	*Stereotype women* M_{rank}	*Non-stereotype* M_{rank}
Prevent: hackers from gaining access to your device	3	11.696	.009**	238.86	220.41	220.99	251.95
Prevent: online stores from misusing your credit card information	3	7.227	.065	235.92	219.28	227.79	249.09
Prevent: advertisers from seeing the website you visit	3	1.679	.642	231.49	236.04	222.05	242.73
Prevent: advertisers from showing you targeted ads based on the websites you visit	3	3.582	.310	227.89	236.57	218.69	249.31
Prevent: the websites you visit from seeing what physical location you are browsing from	3	3.851	.278	244.36	215.44	231.24	240.80
Prevent: your search engine from personalizing the search results you see based on the websites you visit	3	0.183	.980	236.47	229.28	232.65	233.55
Prevent: your internet service provider from seeing the websites you visit	3	1.162	.762	227.32	236.43	226.78	241.73
Prevent: the government from seeing the websites you visit	3	1.411	.703	223.99	230.73	234.32	243.08
Prevent: friends or family with physical access to your device from seeing the websites you visit in your browser history	3	4.113	.250	218.50	223.50	243.68	246.29
Prevent: your employer from seeing the websites you visit on your personal device while connected to your work's WiFi	3	1.796	.616	235.20	222.81	244.08	229.58
Prevent: law enforcement from seeing the websites you visit	3	7.383	.061	209.03	232.13	254.53	236.17
Prevent: companies who own movies from seeing if you illegally stream a movie	3	2.117	.548	222.76	226.03	240.28	242.91

*Note: *p<.05, **p<.01, ***p<.001*

Table 5: Kruskal-Wallis test results comparing interest to prevent various S&P risk scenarios (DV) between the different priming groups (IV) for men.

	df	H-value	Sig.	*Control* M_{rank}	*Stereotype men* M_{rank}	*Stereotype women* M_{rank}	*Non-stereotype* M_{rank}
Prevent: hackers from gaining access to your device	3	0.755	.860	241.23	231.88	231.47	233.33
Prevent: online stores from misusing your credit card information	3	1.153	.764	228.75	238.34	240.65	230.34
Prevent: advertisers from seeing the website you visit	3	1.250	.741	243.86	225.11	234.91	233.95
Prevent: advertisers from showing you targeted ads based on the websites you visit	3	6.139	.105	257.91	216.67	231.42	231.65
Prevent: the websites you visit from seeing what physical location you are browsing from	3	0.488	.922	231.34	230.52	240.87	235.26
Prevent: your search engine from personalizing the search results you see based on the websites you visit	3	2.495	.476	250.50	230.91	225.80	230.62
Prevent: your internet service provider from seeing the websites you visit	3	0.217	.975	237.56	230.06	235.41	234.91
Prevent: the government from seeing the websites you visit	3	5.265	.153	249.56	214.46	231.23	242.45
Prevent: friends or family with physical access to your device from seeing the websites you visit in your browser history	3	2.529	.470	241.20	241.25	218.41	237.14
Prevent: your employer from seeing the websites you visit on your personal device while connected to your work‘s WiFi	3	2.826	.419	242.91	233.20	219.01	242.79
Prevent: law enforcement from seeing the websites you visit	3	3.843	.279	250.63	218.58	230.79	237.74
Prevent: companies who own movies from seeing if you illegally stream a movie	3	1.558	.669	230.15	240.22	243.09	224.63

Table 6: Kruskal-Wallis test results comparing knowledge test performance, and self-assessed knowledge and skills (DV) between the different priming groups (IV) for women.

	df	H-value	Sig.	*Control* M_{rank}	*Stereotype men* M_{rank}	*Stereotype women* M_{rank}	*Non-stereotype* M_{rank}
KnowledgePrivacyTools	3	0.649	.885	229.54	235.90	239.37	227.09
OPLIS_Technical	3	0.509	.917	239.88	231.96	232.00	228.07
KnowHowSelfReportScale	3	0.242	.971	231.03	230.03	232.97	238.01
SelfConfidenceSecurityKnowledge	3	0.138	.987	233.25	229.37	231.64	235.72
TechnicalKnowledge_ General	3	4.785	.188	233.03	221.90	254.29	222.22
TechnicalKnowledge_ ComputerSecurity	3	8.570	.036*	230.94	214.80	262.04	223.50
TechnicalKnowledge_ Privacy	3	4.808	.186	233.70	217.71	253.77	226.27
Skills	3	2.972	.396	235.17	216.95	240.90	238.73

*Note: *p<.05, **p<.01, ***p<.001*

Table 7: Kruskal-Wallis test results comparing knowledge test performance, and self-assessed knowledge and skills (DV) between the different priming groups (IV) for men.

	df	H-value	Sig.	*Control* M_{rank}	*Stereotype men* M_{rank}	*Stereotype women* M_{rank}	*Non-stereotype* M_{rank}
KnowledgePrivacyTools	3	4.947	.176	232.64	214.44	252.94	237.82
OPLIS_Technical	3	1.173	.760	227.60	240.45	228.99	241.07
KnowHowSelfReportScale	3	0.544	.909	229.47	239.53	230.41	238.68
SelfConfidenceSecurityKnowledge	3	1.935	.586	228.08	243.88	241.06	223.17
TechnicalKnowledge_ General	3	0.874	.832	235.28	235.49	241.50	225.74
TechnicalKnowledge_ ComputerSecurity	3	4.644	.200	223.21	243.66	251.00	220.32
TechnicalKnowledge_ Privacy	3	2.789	.425	218.66	239.82	245.94	233.75
Skills	3	0.080	.994	234.63	235.29	236.06	232.03

Table 8: Unpaired t-test results comparing security attitude (SA-13 [20]), technological affinity (ATI [21]), privacy concerns (IUIPC-8 [27, 44]), and security behavior intention (SeBIS [18]) (DV) between women and men (IV). In cases where homogeneity of variance was not given, Welch's t-test was calculated.

					Women		Men	
	df	t-value	Sig.	d	M	SD	M	SD
SA13_Engagement	931	-3.256	.001**	-0.213	3.25	0.96	3.45	0.89
SA13_Attentiveness	931	-3.289	.001**	-0.215	3.33	0.87	3.51	0.82
SA13_Resistance	931	-1.969	.049*	-0.129	2.32	0.80	2.42	0.78
SA13_Concernedness	931	5.795	<.001***	0.379	3.66	0.86	3.33	0.88
SEBIS_DeviceSecurement	931	-0.381	.703		3.91	0.93	3.93	0.91
SEBIS_Updating	923.605	-1.872	.061		3.59	0.91	3.69	0.84
SEBIS_PasswordGeneration	931	0.135	.892		3.67	0.87	3.66	0.83
SEBIS_ProactiveAwareness	931	1.620	.106		3.80	0.77	3.72	0.76
ATI_Overall	923.846	-8.211	<.001***	-0.538	3.34	1.11	3.92	1.03
IUIPC_Control	917.367	4.662	<.001***	0.305	6.18	1.03	5.84	1.17
IUIPC_Awareness	863.300	4.784	<.001***	0.313	6.54	0.83	6.23	1.11
IUIPC_Collection	914.466	5.009	<.001***	0.328	5.99	1.13	5.59	1.30

*Note: *p<.05, **p<.01, ***p<.001*

Table 9: Wilcoxon rank-sum test results comparing interest to prevent various S&P risk scenarios (DV) between women and men (IV).

	Z-value	Sig.	r	Women M_{rank}	Men M_{rank}
Prevent: hackers from gaining access to your device	-3.046	.002**	0.100	485.33	448.79
Prevent: online stores from misusing your credit card information	-2.992	.003**	0.098	485.80	448.32
Prevent: advertisers from seeing the website you visit	-2.730	.006**	0.089	489.81	444.33
Prevent: advertisers from showing you targeted ads based on the websites you visit	-1.345	.179	0.044	478.42	455.65
Prevent: the websites you visit from seeing what physical location you are browsing from	-2.930	.003**	0.096	491.11	443.04
Prevent: your search engine from personalizing the search results you see based on the websites you visit	-2.464	.014*	0.081	488.00	446.13
Prevent: your internet service provider from seeing the websites you visit	-0.121	.903	0.004	468.01	466.00
Prevent: the government from seeing the websites you visit	-0.946	.344	0.031	459.24	474.71
Prevent: friends or family with physical access to your device from seeing the websites you visit in your browser history	-3.231	.001**	0.106	439.63	494.19
Prevent: your employer from seeing the websites you visit on your personal device while connected to your work‘s WiFi	-1.575	.115	0.052	453.99	479.92
Prevent: law enforcement from seeing the websites you visit	-3.706	<.001***	0.121	435.65	498.15
Prevent: companies who own movies from seeing if you illegally stream a movie	-3.624	<.001***	0.119	436.17	497.63

*Note: *p<.05, **p<.01, ***p<.001*

Table 10: Wilcoxon rank-sum test results comparing knowledge test performance, and self-assessed knowledge and skills (DV) between women and men (IV).

	Z-value	Sig.	r	Women M_{rank}	Men M_{rank}
KnowledgePrivacyTools	-9.471	<.001***	0.310	384.43	549.04
OPLIS_Technical	-6.003	<.001***	0.197	416.50	517.18
KnowHowSelfReportScale	-9.039	<.001***	0.296	387.08	546.40
SelfConfidenceSecurityKnowledge	-6.741	<.001***	0.221	406.60	525.01
TechnicalKnowledge_ General	-9.009	<.001***	0.295	389.60	543.90
TechnicalKnowledge_ ComputerSecurity	-8.141	<.001***	0.267	396.52	537.02
TechnicalKnowledge_ Privacy	-8.183	<.001***	0.268	396.19	537.35
Skills	-6.525	<.001***	0.214	416.41	517.27

*Note: *p<.05, **p<.01, ***p<.001*

Table 11: Study participants' demographics per video priming group.

	Women								Men							
	Control		*Stereotype men*		*Stereotype women*		*Non-stereotype*		*Control*		*Stereotype men*		*Stereotype women*		*Non-stereotype*	
Age	*N*	*%*	*N*	*%*	*N*	*%*	*N*	*%*	*N*	*%*	*N*	*%*	*N*	*%*	*N*	*%*
18-20	/	/	/	/	5	4.2	1	0.9	2	1.7	2	1.7	2	1.7	4	3.4
21-25	9	7.7	13	11.3	11	9.3	11	9.6	7	5.9	18	15.5	15	12.8	5	4.3
26-30	12	10.3	15	13.0	14	11.9	13	11.3	31	26.3	20	17.2	21	17.9	15	12.8
31-35	16	13.7	18	15.7	17	14.4	15	13.0	19	16.1	20	17.2	19	16.2	23	19.7
36-40	20	17.1	9	7.8	13	11.0	11	9.6	18	15.3	15	12.9	19	16.2	19	16.2
41-45	12	10.3	6	5.2	14	11.9	10	8.7	12	10.2	7	6.0	18	15.4	8	6.8
46-50	8	6.8	11	9.6	16	13.6	12	10.4	11	9.3	9	7.8	9	7.7	15	12.8
51-55	8	6.8	14	12.2	6	5.1	12	10.4	7	5.9	10	8.6	3	2.6	8	6.8
56-60	13	11.1	10	8.7	9	7.6	12	10.4	3	2.5	5	4.3	8	6.8	11	9.4
61-65	8	6.8	8	7.0	2	1.7	11	9.6	4	3.4	6	5.2	2	1.7	5	4.3
66-70	8	6.8	5	4.3	10	8.5	5	4.3	3	2.5	3	2.6	1	0.9	3	2.6
71-75	2	1.7	4	3.5	1	0.8	1	0.9	1	0.8	/	/	/	/	1	0.9
76-80	1	0.9	2	1.7	/	/	1	0.9	/	/	/	/	/	/	/	
> 80	/	/	/	/	/	/	/	/	/	/	1	0.9	/	/	/	
Education																
School student	/	/	2	1.7	/	/	1	0.9	2	1.7	1	0.9	4	3.4	1	0.9
High School Diploma	42	35.9	31	27.0	46	39.0	40	34.8	44	37.3	35	30.2	36	30.8	39	33.3
Bachelor's Degree	49	41.9	53	46.1	44	37.3	41	35.7	44	37.3	54	46.6	51	43.6	46	39.3
Master's Degree	11	9.4	12	10.4	18	15.3	19	16.5	19	16.1	19	16.4	18	15.4	24	20.5
Ph.D. or higher	4	3.4	4	3.5	1	0.8	/	/	6	5.1	1	0.9	3	2.6	4	3.4
Other	11	9.4	13	11.3	8	6.8	13	11.3	3	2.5	6	5.2	5	4.3	3	2.6
Occupation																
Employed full time	43	36.8	41	35.7	59	50.0	45	39.1	70	59.3	66	56.9	74	63.2	71	60.7
Employed part-time	21	17.9	17	14.8	11	9.3	19	55.7	8	6.8	14	12.1	12	10.3	14	12.0
Unemployed and on the lookout	7	6.0	5	4.3	4	3.4	5	60.0	7	5.9	7	6.0	9	7.7	9	7.7
Unemployed and not on the lookout	2	1.7	1	0.9	3	2.5	/	/	2	1.7	1	0.9	2	1.7	2	1.7
Student	3	2.6	4	3.5	9	7.6	3	2.6	9	7.6	9	7.8	4	3.4	2	1.7
Retired	9	7.7	16	13.9	9	7.6	10	8.7	3	2.5	7	6.0	4	3.4	4	3.4
Homemaker	10	8.5	11	9.6	9	7.6	10	8.7	3	2.5	1	0.9	1	0.9	/	/
Self-employed	16	13.7	17	14.8	13	11.0	18	15.7	15	12.7	9	7.8	10	8.5	14	12.0
Incapacitated for work	3	2.6	2	1.7	1	0.8	5	4.3	1	0.8	/	/	1	0.9	1	0.9
Other	2	1.7	/	/	/	/	/	/	/	/	2	1.7	/	/	/	/
IT Experience																
Yes	23	19.7	24	20.9	21	17.8	21	18.3	49	41.5	50	43.1	50	42.7	53	45.3
No	95	81.2	91	79.1	96	81.4	94	81.7	68	57.6	64	55.2	66	56.4	61	52.1
	M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
Hostile Sexism	2.768	0.766	2.820	0.788	2.689	0.808	2.696	0.721	3.054	0.892	3.083	0.895	3.070	0.841	3.076	0.879
Benevolent Sexism	3.056	0.768	3.187	0.862	3.061	0.841	3.172	0.749	3.214	0.869	3.161	0.844	3.262	0.766	3.365	0.689
Gender Identification	4.765	1.219	4.881	1.235	4.889	1.379	4.873	1.463	4.495	1.426	4.138	1.532	4.524	1.271	4.535	1.363