

Social Status and the Demand for Security and Privacy

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Abstract. High-status decision makers are often in a position to make choices with security and privacy relevance not only for themselves but also for groups, or even society at-large. For example, decisions about security technology investments, anti-terrorism activities, and domestic security, broadly shape the balance between security and privacy. However, it is unclear to what extent the mass of individuals share the same concerns as high-status individuals. In particular, it is unexplored in the academic literature whether an individual's status position shapes one's security and privacy concerns.

The method of investigation used is experimental, with 146 subjects interacting in high- or low-status assignments and the subsequent change in the demand for security and privacy being related to status assignment with a significant *t*-statistic up to 2.9, depending on the specification. We find that a high-status assignment significantly increases security concerns. This effect is observable for two predefined sub-dimensions of security (i.e., personal and societal concerns) as well as for the composite measure. We find only weak support for an increase in the demand for privacy with a low-status manipulation.

We complement these results with a second experiment on individuals' time preferences with 120 participants. We show that the high-status manipulation is correlated with increased patience, i.e., those individuals exhibit more robust long-term appreciation of decisions. Given that many security and privacy decisions have long-term implications and delayed consequences, our results suggest that high-status decision makers are less likely to procrastinate on important security investments, and are more likely to account for future risks appropriately. The opposite applies to privacy and low-status roles.

Keywords: Privacy, Security, Social status, Time Preferences, Experiment, Laboratory

1 Introduction and Research Objectives

With the heightened impact of a broad range of cybercriminal activities and the threat from diffuse terrorist groups, countermeasures and policy activities

that influence the balance between privacy and security have become central societal issues. Many commentators have argued that there is an inherent trade-off related to these two concepts. The common adage is that better security always necessitates concessions on the side of privacy [45].

This belief has been challenged by several security and privacy researchers and advocates. Further, computer scientists have worked on key technologies to gather security-relevant information without unduly impacting individuals' privacy, e.g., in the context of video surveillance [40]. Progress has also been made to disambiguate important overgeneralizations about the privacy-security trade-off. For example, Solove provided a succinct discussion of the nothing-to-hide argument [43].

In contrast, our knowledge about the behavioral trade-off, or to put it differently, the joint demand for security and privacy, remains lackluster. Most studies focus on either security or privacy, but rarely on both variables at the same time. For example, starting with Westin's surveys, countless studies have reported a typically moderate to high average concern for privacy in the subject population (see, for example, [32]). Similarly, the perceived threat of terrorism and cyber-crime is reflected by a heightened overall concern for security (e.g., [15,55]). From an economic perspective, some studies document the existence of a positive (but usually small) willingness-to-pay for additional privacy or information security measures [22,39,48].

Even less is known about factors that moderate the trade-off between security and privacy, and that might be able to explain the apparent heterogeneity of individuals' preferences and behaviors. Our research targets this problem area. In particular, we argue that the relative social status of an individual is an important factor influencing concerns for security and privacy.

Social status may be broadly defined as power and influence hierarchy of the members of a society with accompanying dominance and submissive behaviors [6,7]. Social status is thus a relative, rather than absolute, measure. Social status may include measures of socioeconomic status such as occupation, education, income and wealth. Further, intelligence, age and ethnicity may function as status cues that lead to power and influence within groups [50].

Our method of investigation is experimental with subjects being assigned a role with high or low status, respectively. This allows us to demonstrate causation (instead of merely statistical correlation) from a low/high-status assignment to a shift in the variables under observation. In this paper, we present results from two experiments.

First, we study the impact of the social status manipulation on the demand for security and privacy. We subdivide security concerns into societal and personal dimensions [8].

Second, we report results from a parallel investigation into individuals' time preferences. Specifically, we measure the level of patience, which is the willingness to delay pleasure for an ultimately greater benefit.

Lower socioeconomic status is correlated with less patience (or more impatience), whether it is measured using education, income, or even age [37].

Similarly, many field behaviors that are more prevalent in low-status groups are associated with a high level of impatience, including lack of exercise, smoking and body mass index [10], substance abuse [31,38], and delinquency in juveniles [53]. This literature demonstrates the importance of impatience in shaping unhealthy behaviors, with individuals from lower status groups more frequently procrastinating on important investments into their future wealth or health, or seeking immediate gratification when patience would be to their benefit. However, the existing literature is merely correlational with regards to status and does not demonstrate causation from status to impatience.

Together, the two experiments contribute to a better understanding of how subjects from different social status categories perceive threats to their privacy and security, and whether they are likely able to act upon their preferences in an effective manner.

First, privacy and security decisions by high-status individuals can be aligned or misaligned with the interests of low-status individuals. Our work suggests that social status differences contribute to a misalignment of these interests. Second, effective privacy and security decision-making usually involves the economic evaluation of positive or negative consequences over time [2,3]. For example, revealing data on a social networking site may have short-term benefits, but may also increase the individual's vulnerability to cybercrime (e.g., social phishing [28]) or mass surveillance. However, such negative events typically happen at an unspecified later date. Decision-makers need to be able to account for such scenarios to be able to make privacy and security decisions that limit their exposure to negative events in the future. However, a higher degree of impatience (as evidenced with low-status individuals) would hinder the correct evaluation of such scenarios [18].

The remainder of the paper is structured as follows. We discuss related work in Section 2. In Section 3, we discuss the experimental setup in detail. In Section 4, we present the results of the experiments. Finally, we engage in a discussion of the results and present concluding remarks in Sections 5 and 6, respectively. The Appendix includes the key elements of the experimental instructions and survey measures.

2 Background

Going back to Westin's seminal work [51], the study of individuals' valuation of privacy has been identified as a complex issue and continues to present researchers with theoretical challenges and contradictory empirical revelations (see, for example, Solove [44] and Spiekermann et al. [46]). A number of review articles have summarized findings about the various factors that influence individuals' perceptions, preferences and behaviors regarding privacy (see, for example, Brandimarte and Acquisti [9] and Hui and Png [27]).

Capturing this complexity (and lessons learned) in an adequate decision-making model may appear as an insurmountable task. However, Acquisti and Grossklags provided a high level classification of important factors [3]. First,

individuals are hampered in their decision-making due to information boundaries in the marketplace (such as asymmetric or incomplete information). Second, individuals suffer from their bounded rationality and have to avail themselves of learned or innate heuristics to respond in complex privacy scenarios (such as, for example, by applying *rational ignorance* about too complex matters). Third, certain psychological biases lead to systematic deviations of expected behaviors (e.g., time-inconsistent discounting).

Responding to the third factor, work by Acquisti and colleagues has shown that privacy preferences are malleable, i.e., preferences can be *easily* changed or influenced (see, for example, the previously cited review article [9]). Our work is related to these findings, however, we argue that privacy and security preferences are dependent on the relative social status of an individual within a target population.

Given our careful reading of the related work, our approach is novel from at least three perspectives. First, by utilizing a test-manipulation-retest methodology we can demonstrate causality with respect to privacy and security preferences as a result of the manipulation of social status in the subject population. We are not aware of many studies in the privacy and security fields that apply this methodology (see [4] for an example in the security education context). Second, as described in the introduction, the relative social status of an individual may depend on many important factors such as wealth, professional achievement, and education/skills. It is, therefore, a central aspect of our society that has not, yet, found adequate consideration in the privacy/security literature. Third, we conduct an experiment measuring privacy and security preferences at the same time; a timely topic given the recent revelations about mass surveillance that demand a sophisticated response from decision-makers in business and policy, and the general population.

3 Experimental Setup

In the following, we present the essential building blocks of the two experiments (see Figure 1).

3.1 Overview

Similar to clinical trials for new drugs and experiments in psychology and biology, we conduct measurements (in the form of a survey) of variables of interest before and after a manipulation. This test-manipulation-retest methodology has been applied less often in social science and economic research. The main benefit is that it allows us to clearly address questions of causation between important behavioral measures.

In the first experiment, we measured subjects' privacy and security concerns. The key survey instrument in the second experiment is addressing individuals' time preferences, i.e., how patient are individuals when they are presented with delayed payments. We varied the questions between the test and retest phase to

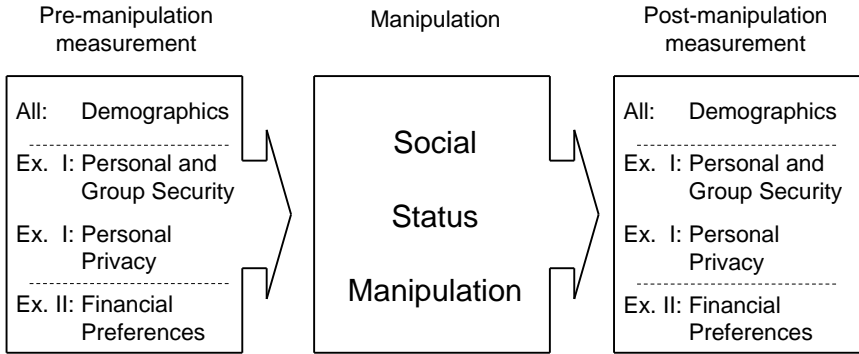


Fig. 1. Overview of Experiments

avoid individuals anchoring on specific responses (i.e., to avoid a carryover effect from the first survey stage to the second survey stage).³

3.2 Social Status Manipulation

The status manipulation utilized is similar to others in the literature (see, for example, [5,23,42,54]), with two subjects working together on a shared task. One subject is assigned to a high-status role (i.e., the Supervisor) and the other subject to a low-status role (i.e., the Worker).

For the manipulation, subjects were seated in same-sex pairs.⁴ After completing the initial questionnaire, the experimenter approached each pair and offered the subject seated closest to the aisle a choice between two pieces of paper. The subject could not see the contents of the paper until after he or she had selected it. The other piece of paper was then given to the second person in the pair. The two pieces of paper described the roles of Supervisor and Worker that the subjects would take in a 2-person work group. These role instructions are included in the Appendix. In brief, the Supervisor was responsible for writing down the group's answers to the task, and the Worker was responsible for advising and helping the Supervisor. To eliminate bias due to the top or bottom piece of paper being chosen more frequently, the order of the two pieces of paper was alternated; if the Supervisor description was on top for one pair, then the Worker description would be on top for the next pair. The verbal instructions given to the subjects were minimal. Subjects were paid the same amount.

³ Common across both experiments, we also included demographic variables and measures of affect (emotion). The latter we do not discuss in detail in this paper.

⁴ This requirement was introduced to eliminate a potential confound related to the interaction of participants with different genders. For example, previous experimental research has provided evidence for performance differences in competitive environments when individuals were part of either same-sex and mixed-sex groups [19].

After the roles had been assigned, the Supervisor was then handed the task instructions. The first page described the task of assigning social responsibility scores to fictitious organizations. The subsequent 5 pages had approximately 2,000 words of text describing 8 fictitious organizations. To encourage the groups to work diligently, an \$80 prize was given to the team with the “best” answers, where “best” was defined as being closest to the average answers of all the groups. The subjects were given 20 minutes to complete the task. Most groups finished the task in about 15 minutes and then continued talking quietly until the experimenter announced the end of this period. We observed that in almost all cases the Supervisor retained the task instructions and, as instructed, wrote down the answers of the group. Since there was only one set of instructions, the Worker had to look over to the Supervisor’s desk to read them.

The experimental setup was designed to isolate the status interaction as the manipulated factor. Hence the two subjects were treated equally, apart from the instructions, and the assignment of roles was transparently random. There was no attempt to devalue either subject or to suggest the Supervisor in any way deserved the role by being “better” than the Worker. Since social status was manipulated, we refer to the Supervisors as the High-Status Group and the Workers as the Low-Status Group.

3.3 Measures for Security and Privacy Experiment

We measured security concern for two different dimensions. First, we considered how participants evaluated security risks from a societal perspective. Specifically, we asked “how concerned are you about the following internet security issues as they may affect society in general?” The sub-questions targeted issues such as terrorism, domestic wiretapping, online crime, child pornography. Second, we asked a number of questions to address individuals’ personal sense of security. We asked “how concerned are you about the following internet security issues as they may affect you personally?” The sub-questions addressed security issues related to the usage of the Internet and personal computers such as viruses, spyware, and online banking. The personal security questions were modeled after surveys conducted, for example, by the National Cyber Security Alliance (e.g., [35]), and inspired by academic research on, e.g., phishing [14], and spyware [20].

The question about privacy was focused on potential concerns about information revelation by the subjects themselves. We asked “how comfortable [you] would be providing [a certain] type of information to Web sites.” The information categories included the subject’s full name, social security number, political orientation etc. This measure of privacy concern was first introduced by Ackermann et al. [1] and reutilized, for example, by Acquisti and Grossklags [3] and Spiekermann et al. [46].

All sub-questions were presented to the participants with a 9-point scale to accurately state the level of their concerns (examples are given in the Appendix). We then averaged the data for each category of questions to derive three quasi-continuous (9-point) rating scales (i.e., Likert-type scales) for social security concerns, personal security concerns, and privacy concerns, respectively. The

summary statistics are provided in Table 1. As previously stated, to reduce anchoring and potential carryover effects, we asked different sub-questions before and after the experimental manipulation.

3.4 Measures for Discounting Experiment

The financial questions are broadly modeled after those of Thaler [47], with the subjects being told they had received a hypothetical prize from their bank with a fixed delay. The subjects were then asked for the amount of money they would need to receive now to make them indifferent compared to receiving the larger amount with a fixed delay. The subjects were asked for their indifference point over amounts that varied widely in magnitude (from tens of dollars to thousands of dollars) and for fixed delays of 1 week, 2 months, and 2 years. To reduce anchoring, slightly different payment amounts were presented after, compared to before, the experimental manipulation.

These financial questions are matching tasks, as defined by Frederick et al. [17]. The subjects were required to state the amount of money that would make them indifferent to the proposed payout. We selected this in preference to a choice task, where subjects make a choice between two alternatives. Choice tasks generate a coarse filtration of preferences unless many questions are asked, and since the experimental manipulation was expected to have only a moderate effect on preferences, it was considered important to have tightly defined financial preferences. Choice tasks allow real, versus hypothetical, decisions to be made, usually with one of the choices having some probability of actually being paid. But the large magnitude of some payment amounts would make such real payments impractical. Other researchers find little difference between the real and hypothetical answers, e.g., [29,30,34], obviating the need for real rewards. Choice tasks can also be easier to understand than matching tasks and, indeed, several subjects reported difficulty understanding the financial questions. This was perhaps the main disadvantage of using a matching task.

The financial questions allowed us to estimate discount factors for each subject for the three time periods (1 week, 2 months, and 2 years) for the questions asked before and after the experimental manipulation. For each future payment amount, we took the subject's immediate value and then divided by the future amount to calculate a discount factor for that payment. For example, the subjects were asked how much they would need to receive now to make them indifferent to receiving \$80 in 2 months. If the subject stated they would need to receive \$60 now, then their discount factor for that payment would be 0.75 ($\$60/\80). The discount factors for each time period were then averaged for each subject, as presented in Table 3.

3.5 Apparatus and Subject Payments

The questionnaires were conducted on computers using z-Tree [16]. The experimental manipulation was a group interaction with instructions given on paper. The complete experimental sessions lasted just under an hour and the subjects

were paid \$15 for their participation (plus a potential bonus payment as discussed above; the bonus payment was divided equally between the Supervisor and Worker).

Our research protocol and apparatus has been reviewed and approved by an Institutional Review Board for experiments with human subjects.

4 Data and Results

4.1 Subject Recruiting and Demographics

A total of 266 undergraduate students from the University of California at Berkeley participated in the experiments which were held at the Experimental Social Science Laboratory (Xlab). The experiments were advertised to a pool of students who previously indicated their interest to participate in economic studies.

Table 1. Summary statistics for the demand for security and privacy

	Security	Personal	Societal	Privacy
No. Obs.	146	146	146	146
Mean	6.482	6.988	5.976	5.331
StDev	1.491	1.638	1.778	1.486
Skew	-0.626	-1.040	-0.398	-0.044
Kurtosis	0.315	0.932	-0.178	0.016

For the security and privacy experiment, we successfully invited 146 individuals. We did not exclude any subjects from the analysis. Of the 146 participants, 96 (64.4%) were female. On average, participants had already gained over two years of college experience which is roughly equivalent to the level of junior students in the United States undergraduate system.

For the discounting experiment, we recruited 120 subjects. The 9 subjects who answered zero to any of the financial questions were excluded from the analysis because placing a zero value on future cash flows indicates that they may not have fully understood the questions. This left 111 subjects whose responses we analyze. Of the 111 participants, 64 (57.7%) were female. Similar to the group of participants in the security/privacy experiment, participants had (on average) already gained over two years of college experience equivalent to the level of junior students.

4.2 Results for the Security and Privacy Experiment

The summary statistics for the security and privacy experiment are reported in Table 1. For these static measurements, security concerns trump privacy concerns by about one point on the 9-point rating scale, and personal security concerns are somewhat larger than societal security concerns. On average, individuals are

more than “somewhat concerned” about security, and less than “somewhat comfortable” to share personal information online which (i.e., these levels constitute the middle points of the given rating scales; see selected questions and scales in the Appendix).

Table 2. Impact of experimental manipulation on the demand for security and privacy

Change in Dependent Variables:	Security	Personal	Societal	Privacy
Supervisor	0.425	0.335	0.514	0.061
Worker	0.068	-0.006	0.143	0.248
Difference	0.356	0.341	0.371	-0.187
Robust Standard Error	0.124	0.152	0.177	0.158
(<i>t</i> -statistic)	2.876	2.244	2.095	-1.189
<i>p</i> -value	0.005**	0.026*	0.038*	0.237

To test the impact of the experimental manipulation, we conducted an ordinary least-squares (OLS) regression with Huber-White (robust) standard errors [25,52]. Regressions with robust standard errors are a standard approach in economics and finance to account for data with some imperfections and minor concerns about failure to meet assumptions about normality, heteroscedasticity, or some observations that exhibit large residuals, leverage or influence [11].

The experimental manipulation leads to a relative increase of security concerns for the high-status assignment (see Table 2). This effect is statistically significant for the two components of security concern as well as the composite measure. In contrast, privacy concerns are relatively higher for subjects in the low-status condition, but this effect is not statistically significant.

4.3 Results for the Discounting Experiment

Table 3 captures the discount factors observed for the 111 experimental subjects that supplied us with valid data. As expected, participants’ indifference point for equating an amount now in comparison with a delayed fixed payment is decreasing with an increase in advertised delay. That is, individuals’ indifference point for receiving an amount now instead of a dollar after one week is about 82 cents. Whereas a payment delay of two years pushes the indifference point down to about 62 cents. Put differently, individuals are satisfied with lower monetary amounts now when facing longer delays. This effect is rational since a longer delay prevents individuals from accomplishing alternative objectives (such as purchasing goods or investing the money) for a longer period of time.

However, individuals behave less rationally concerning the magnitude of their discounting choices. Equating 82 cents now with a one dollar payment after one week resembles an extraordinarily large discount rate. The same applies to the other two time intervals.

Taken together, participants consistently adapt their valuation when shifting between different delay options, however any delay at all is treated very harshly.

Table 3. Summary statistics for discounting behavior

	1 Week	2 Months	2 Years	Average
No. Obs.	111	111	111	111
Mean	0.821	0.785	0.624	0.744
StDev	0.235	0.218	0.250	0.203
Skew	-1.591	-1.307	-0.492	-0.875
Kurtosis	1.824	1.117	-0.575	0.014

In general, this will lead subjects to seek rewards that are available now, and delay investments that yield benefits in the future. Similar findings have been reported in a survey study by Acquisti and Grossklags [3].

Our analysis regarding the impact of the experimental manipulation follows the same approach as outlined in Section 4.2. When evaluating the impact of the experimental manipulation, we observe that the different status assignments lead to relative changes in the discounting behavior. The high-status Supervisors experience an increase in the value of the delayed payments with, for example, the value of \$1.00 in 1 week increasing by \$0.010. Conversely, the low status Workers experience a decrease in the value of the delayed payments with, for example, the value of \$1.00 in 1 week decreasing by \$0.049. The difference between the preference changes of the Supervisors and Workers is \$0.059 for the 1 week period and \$0.056 for the 2 month period; both are statistically significant. Furthermore, the average difference across the 3 time periods is \$0.051, which is statistically significant at the 1% level. Hence this experiment demonstrates that a low, rather than high, status level leads to a relatively greater focus on immediate rewards.

Table 4 also enables us to estimate the impact of the social status manipulation on an impulsiveness metric that is defined as one minus the 1-week discount factor. The average initial metric is 0.179 ($1.00 - 0.821$). Following the status manipulation, the high status group's impulsiveness falls to 0.169 ($0.179 - 0.010$) while the low status group's impulsiveness increases to 0.228. The level of impulsiveness is 35 percent (i.e., $0.228/0.169 - 1.00$) higher for the low-status role compared to the high-status role as a result of the status manipulation.

Table 4. Impact of experimental manipulation on discounting factor

Change in Dependent Variables	1 Week	2 Months	2 Years	Average
Supervisor	0.010	0.026	0.020	0.018
Worker	-0.049	-0.030	-0.018	-0.032
Difference	0.059	0.056	0.037	0.051
Robust Standard Error	0.025	0.024	0.027	0.019
(<i>t</i> -statistic)	2.317	2.309	1.395	2.632
<i>p</i> -value	0.021*	0.021*	0.163	0.008**

5 Discussion

Our results are derived from an experimental laboratory study. We designed a controlled environment to carefully isolate and manipulate an important factor, and created experimental manipulations to demonstrate causation as a result of these manipulations. Experimental economics studies that intersect with the field of computer science have become more popular in recent years, and our work contributes to this literature [21].

Our experiment is run in the tradition of experimental economics [41]. According to the standard in this research field, the experiment has taken place in a laboratory which exclusively runs experiments without deception, and we did not utilize any such techniques [36].

With our experiment, we did not aim for an experimental environment that closely mimics a realistic privacy and security decision-making situation. Our research question is novel in the literature, and we attempted to create a relatively abstract experimental setup that will be the basis for follow-up studies which can be conducted outside the laboratory, or with a more complex decision-making environment in the laboratory. For example, as a next step, a status manipulation within the framework of a valuation of private information study would be suitable [22].

Our experimental subjects were drawn from a standard student pool for experiments. While the degree of their privacy and security concerns may not have been fully representative of the wider population (e.g., students may be more computer literate), it is reasonable to assume that their preferences changed in response to the same stimuli that other types of subjects would react to [24]. Hence, our manipulation has relevance for the wider policy discussion. Nevertheless, a useful validation step would be to conduct the experiment with different subject populations; maybe even drawn from societies that differ from the Western cultures [24].

Exploring our research question in a more complex laboratory environment or outside the laboratory may give us insights about the relative importance of the observed factors in relation to other real-world factors. However, the lack of control and the need to consider multiple decision-making factors makes these approaches a less suitable first research step. Research exists to guide researchers into the direction of incrementally increasing the realism of studies inside and outside the laboratory [33].

Returning to our experimental findings, we provide robust evidence for the assertion that high-status decision-makers are likely to express higher concerns for security issues than low-status individuals. This applies to personal and societal concerns. Questions about personal concerns included whether participants were concerned about using an internet café with unencrypted data transfer, or about a virus deleting data from their hard disk. Questions about societal matters included whether individuals were concerned about governments snooping on their citizens, or whether they were concerned about terrorists using the Internet for attacks. Questions about personal concerns were aimed at affect-

ing the individual more directly, whereas the questions about societal concerns addressed issues of broader concerns.

As with most experimental results, the findings may appear easy to rationalize in hindsight and, indeed, they are consistent with observations about the real world [49]. After all, individuals of high social status (which also include those with high socioeconomic status) may feel, for example, that they have more to protect (e.g., according to absolute measures of net wealth, but also other measures of social status). In contrast, one could argue that low-status individuals may feel more concerned about any loss due to security incidents. By providing actual data, our experimental finding is, therefore, from a psychological perspective surprising and provides insights into the reasoning of individuals from different social status categories.

We also find initial evidence for a second observation, i.e., that low-status assignments trigger a relatively higher demand for privacy. This observation is, however, not statistically significant (presumably for lack of power) and requires follow-up research. Assuming that this evidence would be validated in future research, it can be partly explained with individuals' desire to shield themselves from scrutiny if they perceive themselves as deviating from a more desirable state [26]. Participants with a low-status assignment may have found themselves at a disadvantage relative to their partners and this effect then triggered an increased demand for privacy.

We also noted that effective privacy and security decision-making usually involves the economic evaluation of decisions that may cause positive or negative consequences over long periods of time [2,3]. For example, investing into additional security measures now, may deter an attack or may defend an individual against an intrusion attempt at a much later time. From previous research, we know that individuals suffer from a desire for immediate gratification and exhibit often signs of procrastination. Our results from the experiment on time preferences shed light at the question whether individuals from different social status categories share the same magnitude of impatience in their decision-making. We find that low-status individuals are significantly more impatient, and we measure the strength of this effect on tasks that involve monetary comparisons.

Combining the findings from the two experiments, we conclude that high-status individuals are less prone to procrastinate on important security investments (or also privacy-enhancing activities) that address their personal and societal concerns. In contrast, low-status individuals are more likely failing to take appropriate actions that reflect their increased concerns for privacy due to their heightened tendency for procrastination. These findings have direct implications for the utilization of security and privacy-enhancing technologies. For example, while individuals may be capable to state their specific concerns about security and privacy, the likelihood to act to protect themselves may differ based on the level of impatience. This is a further factor that contributes to the explanation of the gap between privacy preferences and privacy behaviors exhibited in previous experimental research [46].

Security and privacy decisions taken by individuals will affect others through externalities. For example, individuals on social networking sites may (through their actions) reveal private information about their peers to undesirable third-parties. Similarly, individuals who suffer from security breaches may have their resources being abused for spam or may contribute to the weakening of the defenses of an organization.

In addition, individuals may act as decision-makers for groups or even larger populations, and may exercise power and influence over these groups. Typically, such positions are associated with a higher relative social status. Our findings may also apply to these scenarios. That is, high-status individuals may focus on their own heightened concerns for security; and may not appropriately consider the increased privacy-concerns of low-status individuals. It is, therefore, conceivable that the privacy and security interests of different social status categories are misaligned. Another finding is that high-status decision-makers will also be more patient in their actions, and less prone to procrastinate on decisions. Depending on what privacy and security measures are considered this could be a benefit or a disadvantage from the perspective of low-status individuals.

In practice, (self-)regulatory efforts in the domains of privacy and security are subject to many factors of influence. Our findings are one contributory factor for decision-making in the public domain, but need to be considered in light of the increasing complexity of privacy and security policy [13].

6 Conclusions

By introducing social status as a mediating factor in a test-manipulation-retest study format we were able to demonstrate causality between high/low-status assignments and their relative impact on the demand for security and privacy, and timing preferences.

Our results complement the sparse empirical literature on the privacy/security trade-off (e.g., [39]) and shift the focus away from mere descriptive work on privacy and security concerns towards studies that increase our understanding of the impact of several important mediating variables.

Our research is timely given the heated debate about the appropriate balance between the enactment of (secret) security measures and the protection of privacy and civil liberties. In particular, the report and recommendations of the Presidents Review Group on Intelligence and Communications Technologies clearly highlight the various battlegrounds related to the unprecedented use of mass surveillance technologies [12].

High-status individuals are typically in the position to make decisions for many others who may have other personal preferences. Our findings highlight one contributory factor of why high-status decision-makers may favor security measures at the expense of civil liberties and privacy.

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References

1. M. Ackerman, L. Cranor, and J. Reagle. Privacy in e-commerce: Examining user scenarios and privacy preferences. In *Proceedings of the ACM Conference on Electronic Commerce (EC'99)*, pages 1–8, 1999.
2. A. Acquisti and J. Grossklags. Privacy attitudes and privacy behavior: Losses, gains, and hyperbolic discounting. In J. Camp and S. Lewis, editors, *The Economics of Information Security*, pages 165–178. Kluwer Academic Publishers, 2004.
3. A. Acquisti and J. Grossklags. Privacy and rationality in individual decision making. *IEEE Security & Privacy*, 3(1):26–33, Jan.–Feb. 2005.
4. V. Anandpara, A. Dingman, M. Jakobsson, D. Liu, and H. Roinestad. Phishing IQ tests measure fear, not ability. In S. Dietrich and R. Dhamija, editors, *Financial Cryptography and Data Security*, volume 4886 of *Lecture Notes in Computer Science*, pages 362–366. Springer Berlin Heidelberg, 2007.
5. C. Anderson and J. Berdahl. The experience of power: Examining the effects of power on approach and inhibition tendencies. *Journal of Personality and Social Psychology*, 83:1362–1377, 2002.
6. N. Barradale. Social incentives and human evolution, 2009. Available at SSRN Paper No. 1520206.
7. N. Barradale. *Essays in Social Status and Finance*. PhD thesis, University of California, Berkeley, 2010.
8. P. Bilgin. Individual and societal dimensions of security. *International Studies Review*, 5(2):203–222, 2003.
9. L. Brandimarte and A. Acquisti. The economics of privacy. In M. Peitz and J. Waldvogel, editors, *The Oxford Handbook of the Digital Economy*, pages 547–571. Oxford University Press, 2012.
10. C. Chabris, D. Laibson, C. Morris, J. Schuldt, and D. Taubinsky. Individual laboratory-measured discount rates predict field behavior. *Journal of Risk and Uncertainty*, 37:237–269, 2008.
11. X. Chen, P. Ender, M. Mitchell, and C. Wells. *Regression with Stata*. Stata Web Books, 2003. Available at: <http://www.ats.ucla.edu/stat/stata/webbooks/reg/default.htm>.
12. R. Clarke, M. Morell, G. Stone, C. Sunstein, and P. Swire. Liberty and security in a changing world: Report and recommendations of The Presidents Review Group on Intelligence and Communications Technologies, December 2013.
13. S. Davies. When privacy reform gets as dirty as environmental reform, we're all in trouble. *The Privacy Surgeon*, June 2013. Blog article available at: <http://www.privacysurgeon.org/>.

14. R. Dhamija, J. Tygar, and M. Hearst. Why phishing works. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems (CHI'06)*, pages 581–590, 2006.
15. K. Drakos and C. Mller. Terrorism risk concern in europe. *Economics Letters*, 112(2):195–197, August 2011.
16. U. Fischbacher. z-tree: Zurich toolbox for ready-made economic experiments. *Experimental Economics*, 10(2):171–178, 2007.
17. S. Frederick, G. Loewenstein, and T. O’Donoghue. Time discounting and time preference: A critical review. *Journal of Economic Literature*, 40:351–401, 2002.
18. M. Ghafurian and D. Reitter. Impatience, risk propensity and rationality in timing games. In *Proceedings of the 36th Annual Conference of the Cognitive Science Society (CogSci)*, 2014.
19. U. Gneezy, M. Niederle, and A. Rustichini. Performance in competitive environments: Gender differences. *Quarterly Journal of Economics*, 118(3):1049–1074, August 2003.
20. N. Good, R. Dhamija, J. Grossklags, S. Aronovitz, D. Thaw, D. Mulligan, and J. Konstan. Stopping spyware at the gate: A user study of privacy, notice and spyware. In *Proceedings of the Symposium On Usable Privacy and Security (SOUPS 2005)*, pages 43–52, 2005.
21. J. Grossklags. Experimental economics and experimental computer science: A survey. In *Proceedings of the Workshop on Experimental Computer Science (ExpCS’07)*, 2007.
22. J. Grossklags and A. Acquisti. When 25 cents is too much: An experiment on willingness-to-sell and willingness-to-protect personal information. In *Proceedings of the Sixth Workshop on Economics of Information Security (WEIS)*, Pittsburgh, PA, 2007.
23. J. Hall, J. Carter, and T. Horgan. Status roles and recall of nonverbal cues. *Journal of Nonverbal Behavior*, 25:79–100, 2001.
24. J. Henrich, S. Heine, and A. Norenzayan. The weirdest people in the world? *Behavioral and Brain Sciences*, 33(2-3):61–83, June 2010.
25. P. Huber. The behavior of maximum likelihood estimates under nonstandard conditions. In *Proceedings of the Fifth Berkeley Symposium on Mathematical Statistics and Probability*, pages 221–233, 1967.
26. B. Huberman, E. Adar, and L. Fine. Valuating privacy. *IEEE Security & Privacy*, 3(5):22–25, 2005.
27. K. Hui and Png I. Economics of privacy. In T. Hendershott, editor, *Handbook of Information Systems and Economics*, pages 471–497. Elsevier, 2006.
28. T. Jagatic, N. Johnson, M. Jakobsson, and F. Menczer. Social phishing. *Communications of the ACM*, 50(10):94–100, October 2007.
29. M. Johnson and W. Bickel. Within-subject comparison of real and hypothetical money rewards in delay discounting. *Journal of the Experimental Analysis of Behavior*, 77:129–146, 2002.
30. S. Kachelmeier and M. Shehata. Examining risk preferences under high monetary incentives: Experimental evidence from the People’s Republic of China. *American Economic Review*, 82:1120–1141, 1992.
31. K. Kirby, N. Petry, and W. Bickel. Heroin addicts have higher discount rates for delayed rewards than non-drug-using controls. *Journal of Experimental Psychology*, 128:78–87, 1999.
32. P. Kumaraguru and L. Cranor. Privacy indexes: A survey of Westin’s studies, 2005. Available as ISRI Technical Report CMU-ISRI-05-138.

33. S. Levitt and J. List. What do laboratory experiments measuring social preferences reveal about the real world? *The Journal of Economic Perspectives*, 21(2):153–174, Spring 2007.
34. G. Madden, B. Raiff, C. Lagorio, A. Begotka, A. Mueller, D. Hehli, and Wegener A. Delay discounting of potentially real and hypothetical rewards: II. Between- and within-subject comparisons. *Experimental and Clinical Psychopharmacology*, 12:251–261, 2004.
35. NCSA/Norton (National Cyber Security Alliance and Norton by Symantec). 2010 NCSA / Norton by Symantec Online Safety Study, 2010. Available at: <http://www.staysafeonline.org/>.
36. A. Ortmann and R. Hertwig. The costs of deception: Evidence from psychology. *Experimental Economics*, 5(2):111–131, October 2002.
37. S. Reimers, E. Maylor, N. Stewart, and N. Chater. Associations between a one-shot delay discounting measure and age, income, education and real-world impulsive behavior. *Personality and Individual Differences*, 47(8):973–978, 2009.
38. B. Reynolds. A review of delay-discounting research with humans: Relations to drug use and gambling. *Behavioural Pharmacology*, 17:651–667, 2006.
39. N. Robinson, D. Potoglou, C. Kim, P. Burge, and R. Warnes. Security, at what cost? Quantifying people’s trade-offs across liberty, privacy and security, 2010.
40. J. Schiff, M. Meingast, D. Mulligan, S. Sastry, and K. Goldberg. Respectful cameras: Detecting visual markers in real-time to address privacy concerns. In A. Senior, editor, *Protecting Privacy in Video Surveillance*, pages 65–89. Springer, 2009.
41. V. Smith. Economics in the laboratory. *Journal of Economic Perspectives*, 8(1):154–158, Winter 1994.
42. S. Snodgrass. Further effects of role versus gender on interpersonal sensitivity. *Journal of Personality and Social Psychology*, 62:154–158, 1992.
43. D. Solove. “I’ve got nothing to hide” and other misunderstandings of privacy. *San Diego Law Review*, 44:745–772, 2007.
44. D. Solove. *Understanding Privacy*. Harvard University Press, Cambridge, MA, 2008.
45. D. Solove. *Nothing to Hide: The False Tradeoff between Privacy and Security*. Yale University Press, New Haven, CT, 2011.
46. S. Spiekermann, J. Grossklags, and B. Berendt. E-privacy in 2nd generation e-commerce: Privacy preferences versus actual behavior. In *Proceedings of the ACM Conference on Electronic Commerce (EC)*, pages 38–47, Tampa, FL, October 2001.
47. R. Thaler. Some empirical evidence on dynamic inconsistency. *San Diego Law Review*, 8:201–207, 1981.
48. J. Tsai, Egelman S., L. Cranor, and A. Acquisti. The effect of online privacy information on purchasing behavior: An experimental study. *Information Systems Research*, 22(2):254–268, June 2011.
49. D. Watts. *Everything is obvious: How common sense fails us*. Crown Business, New York, 2012.
50. M. Webster. Working on status puzzles. In S. Thye and J. Skvoretz, editors, *Advances in Group Processes*, pages 173–215. Elsevier Ltd., 2003.
51. A. Westin. *Privacy and freedom*. Atheneum, New York, 1970.
52. H. White. A heteroskedasticity-consistent covariance matrix estimator and a direct test for heteroskedasticity. *Econometrica*, 48(4):817–838, 1980.
53. J. White, T. Moffitt, A. Caspi, D. Bartusch, D. Needles, and M. Stouthamer-Loeber. Measuring impulsivity and examining its relationship to delinquency. *Journal of Abnormal Psychology*, 103:192–205, 1994.

54. B. Wojciszke and A. Struzynska-Kujalowicz. Power influences self-esteem. *Social Cognition*, 25:472–494, 2007.
55. S. Youn and M. Lee. The determinants of online security concerns and their influence on e-transactions. *International Journal of Internet Marketing and Advertising*, 5(3):194–222, 2009.

A Appendix: Experimental Materials

A.1 Instructions for Worker

CONGRATULATIONS! You have been assigned to the role of WORKER in your group. You are expected to help the other group member, the SUPERVISOR, in a decision-making task. The task involves making a series of decisions concerning the social responsibility of organizations. While all decisions are the responsibility of the SUPERVISOR, you should have an important contribution by giving the SUPERVISOR a second opinion and generally acting in a supporting role.

The pay for each group member has been set at \$15 for the experiment. In addition, your group may receive a performance bonus of \$80, to be split equally. When you are finished reading these instructions, please turn the sheet over and display it prominently at your workspace so the experimenter can see your role. Then read the instructions for the social responsibility task. The SUPERVISOR will write down the answers to the questions on that task.

(On reverse, in large font:) WORKER

A.2 Instructions for Supervisor

CONGRATULATIONS! You have been assigned to the role of SUPERVISOR in your group. You are responsible for the performance of your group in a decision-making task. The task involves making a series of decisions concerning the social responsibility of organizations. The other group member, the WORKER, is expected to help you and provide a second opinion, but all decisions are your responsibility.

The pay for each group member has been set at \$15 for the experiment. In addition, your group may receive a performance bonus of \$80, to be split equally. When you are finished reading these instructions, please turn the sheet over and display it prominently at your workspace so the experimenter can see your role. Then read the instructions for the social responsibility task. As the SUPERVISOR, you will write down the answers to the questions on that task.

(On reverse, in large font:) SUPERVISOR

A.3 Task Instructions

Organizations vary in their level of social responsibility. They go to different lengths to protect the interests of local communities, the environment, their employees, their suppliers and customers, and the disadvantaged members of

society. Ratings of social responsibility can be based either on objective criteria or on the public's perception of the organization. Surveys are one method of eliciting the public's perception of social responsibility, and those surveys may be completed in a group setting.

Your task is to rate organizations on their social responsibility. You will be given descriptions of fictitious organizations that you will rate on a scale of 1-9, where 9 denotes an organization that is extremely socially responsible. As a reward for performance, the group that has the best answers will be given a bonus payment of \$80. The "best answers" are defined as those closest to the average of all the groups completing the exercise. Hence, one strategy is to rate each organization based on your expectation of the average response for all the groups.

Please discuss the answers quietly in your group. No communication with other groups is allowed. To prevent cheating, each group has a different set of questions, with organizations shown in a different order and assigned different letters. Write your rating for each organization immediately below the description of the organization.

You will have approximately 2 minutes to rate each organization. The experimenter will let you know when there are 5 minutes and 1 minute remaining on the task. At the completion of the task, you must stop writing and hand back the questions and answers.

A.4 Discounting Experiment Question

You have won a NOW-or-LATER Prize in a lottery organized by your bank. The bank will either pay you a smaller amount NOW or a larger amount LATER (assume there is no risk of the payment not happening).

Consider the following LATER amounts and dates. For each, you must decide on the NOW amount that would make you indifferent between receiving the NOW amount and the LATER amount.

(If the NOW amount is too high, you would rather receive that. If it is too low, you would rather receive the LATER amount. You will be indifferent somewhere between the two.)

(Note there is no "correct" answer - the question is merely asking about your preference.)

- \$4,400 in 2 months vs. \$ Now:
- \$2,500 in 2 years vs. \$ Now:
- \$1,900 in 1 week vs. \$ Now:
- \$240 in 1 week vs. \$ Now:
- \$300 in 2 years vs. \$ Now:
- \$27 in 1 week vs. \$ Now:
- \$48 in 2 years vs. \$ Now:
- \$80 in 2 months vs. \$ Now:
- \$730 in 2 months vs. \$ Now:

A.5 Questions for Security and Privacy Experiment

How concerned are you about the following internet security issues as they may affect society in general? (1 = Not concerned at all; 5 = somewhat concerned; 9 = Very concerned)

- The use of the internet by race-hate groups to spread propaganda
- Oppressive governments using the internet to snoop on their populations
- Social networking sites being used by pedophiles to contact children
- The limited resources of law enforcement agencies to deter online crime
- Online users bullying and intimidating one another
- Profits from internet activities funding organized crime groups
- The vulnerability of the national internet infrastructure to attack by hostile governments and terrorists
- The use of the internet by terrorist groups to organize attacks

How concerned are you about the following internet security issues as they may affect you personally? (1 = Not concerned at all; 5 = somewhat concerned; 9 = Very concerned)

- People using the internet to withdraw money from your bank account
- Using internet cafes with unencrypted data transfer
- Employers searching for information about you online
- Your ISP selling your data
- Spyware becoming installed on your computer
- Your computer being taken over as part of a botnet
- A virus deleting data from your hard disk

When visiting Web sites that collect information, many people find there is some information that they generally feel comfortable providing, some information they feel comfortable providing only under certain conditions, and some information that they never or rarely feel comfortable providing. For each of the types of information in the left most column, please indicate how comfortable you would be providing that type of information to Web sites. (1 = Very comfortable; 5 = Somewhat comfortable; 9 = Not comfortable at all)

- Full name
- Home address
- Your weight
- Outside work and study interests
- Social network user name/address
- Social security number
- Political orientation
- Driving record
- High school grades