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Simeon Schudy[*] Verena Utikal[†]

Abstract

Privacy regulations can affect the willingness to collect personal health data that may be disclosed to insurers. Perfect privacy cannot always be guaranteed. Consequently, people may refrain from collecting personal health data. This paper provides a theoretical and experimental analysis of the importance of privacy regulations for information acquisition and disclosure behavior. We contrast three institutional settings in a simple game of persuasion: Disclosure Duty of collected data, Perfect Privacy and Imperfect Privacy. Under Perfect Privacy there exists a unique proper equilibrium with complete information acquisition. For Disclosure Duty no information acquisition is predicted. Imperfect Privacy can result in multiple equilibria. Our laboratory experiment confirms the qualitative differences on information acquisition for Perfect Privacy and Disclosure Duty. Behavior under Imperfect Privacy turns out to be very similar to Perfect Privacy: Imperfect Privacy does not stop people from collecting personal information. We discuss possible reasons for the observed behavior.

JEL Classification: C90, D80, D82, I10

Keywords: data privacy; endogenous information acquisition; health; experiment; unraveling

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1 Introduction

Regular visits to the doctor or undertaking specific medical tests such as tests for chronic diseases, sexually transferable diseases (STDs) or genetic tests are important for the prevention and for early interventions of serious diseases. These tests generate data. As it is in insurers' interest to discriminate among different health types, insurers would benefit from access to such data. Anticipating this discrimination, patients may become reluctant to take medical tests and thereby society forgoes potential benefits from early prevention.[1] Some data privacy regulations explicitly involve such a risk of discrimination, for instance *Disclosure Duty*, an environment, in which patients have to disclose collected information when contracting with an insurer. Other institutions, such as *Consent Law*, aim at leaving patients in full control of their collected data and let patients themselves decide whether or not to disclose their health information.[2] While the welfare implications of these regulatory institutions have been discussed in the literature (see e.g. Bardey et al., 2014; Barigozzi and Henriet, 2011; Doherty and Thistle, 1996; Hoy and Polborn, 2000; Peter et al., 2014), a central aspect concerning such institutions has so far been neglected: Perfect privacy, in particular for health data – as assumed under *Consent Law*-, cannot always be guaranteed. First, information about personal health attributes has often to be generated through the help of third parties (e.g. doctors) and thus patients are not in full control of their personal data. Second, technological advances have increased the possibilities of health and genetic testing such that more and more data can be collected, stored and accessed,[3] which has put data privacy

[1] See also Hirshleifer (1971) for a similar argument.

[2] In addition to Consent Law and Disclosure Duty, several other approaches have been discussed in the context of genetic tests, see e.g. Barigozzi and Henriet (2011) who also consider the Laissez-Faire approach, under which insurers can access test results and require additional tests and Strict Prohibition of the use of test results.

[3] See also Kierkegaard (2011) who discuss the merits and weaknesses of a centralized European health record system as planned by the European Commission's Directive 2011/24/EU.

issues to public and legal debate.[4] Third, recent incidents of leakage and data breaches, e.g. in 2007, where hundreds of thousands of UK National Health Service patients' details were lost[5], have remembered the public that perfect control over personal data may be a naïve conjecture.[6]

We provide a twofold contribution to this literature. First, we study theoretically whether imperfect privacy (i.e. a Consent Law environment where patients are not in full control of their collected data due to a positive probability of involuntary data transfer) is already sufficient to make people stop collecting personal health data. Second, we enrich the theoretical discussion with experimental evidence. Although there is observational data available for differences in medical testing and privacy institutions across countries (for instance data on HIV tests across countries provided by WHO and the Data Privacy Index provided by Privacy International), it is difficult to estimate the causal effect of privacy institutions on testing behavior empirically due to cultural differences across countries, differences in access to medical testing and differences in rules with respect to testing (e.g. opt-in and opt-out rules for HIV testing for pregnant women etc.). Our laboratory experiment is the first to shed light on the causal effect of the three different institutions (*Disclosure Duty*, Consent Law with *Perfect Privacy* and *Imperfect Privacy)* on testing and disclosure behavior.[7]

Our theoretical framework is a simplified game of persuasion that captures the main incentive structures people face in the context of acquisition and disclosure of personal health data. We

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[4] For a discussion with respect to legal aspects see also Peppet (2011).

[5] See http://news.bbc.co.uk/2/hi/uk_news/7158019.stm (downloaded: September 2013).

[6] While we focus on health related insurance contexts, similar incentive problems may arise in environments such as firms testing for product qualities and revealing potential risks to consumers.

[7] Recently in a different setting, Bardey et al. (2014) also complement their theoretical analysis on different regulatory institutions for genetic testing with an experiment. However, their experimental design focuses on the joint decision of choosing a privacy institution and testing for one's type using a series of individual lottery choice tasks.

focus on the decision to take tests which reveal information that is valuable to the insurer, e.g. information about people's unchangeable health attributes (such as results from tests for chronic diseases or genetic tests). Results from such tests reveal relevant information as soon as they have been taken (irrespective of whether the test is taken several times) such that the decision to test reflects a one shot decision of an inexperienced actor. Patients decide whether to collect information about their own health status - which can be good or bad. Thereafter they decide whether or not to disclose the collected information to persuade the insurer to offer a contract. The information transferred affects the prospects for a contract with the insurer, because the insurer's profits depend on the patient's health status. The insurer will contract with an identified good health type but will refuse to contract with an identified bad type. Because the insurer cannot directly identify whether a test has been conducted, it depends on the institutional setting whether or not the insurer will contract with an unknown type.[8]

The three privacy institutions we study differ with respect to how information, collected through testing, is transferred to the insurer: First, we study a situation in which patients have to disclose collected information when contracting with an insurer (*Disclosure Duty*). This setup is the regulatory rule for instance in New Zealand, the UK and Germany when it comes to genetic testing (see Barigozzi and Henriet, 2011). Second, we investigate voluntary disclosure of collected information (from now on *Perfect Privacy*). *Perfect Privacy* is equivalent to Consent Law implemented e.g. for genetic testing, for instance, in the Netherlands and Switzerland (ibid.).[9] Third, we introduce an institution in which data privacy cannot be guaranteed (from now

[8] Our framework may also interpreted as a situation in which the insurer offers two tariffs, one for good and one for bad health types.

[9] Consent Law describes the situation in which consumers "are not required to divulge genetic tests results. But, if they do, insurers may use this information" (Viswanathan et al., 2007, 68).

on *Imperfect Privacy*). This institution reflects Consent Law with the additional possibility of data loss, which enters our theoretical model in a probabilistic way.

We show that given insurers are ex ante willing to contract with unknown health types, the only Proper Equilibrium (Myerson, 1978) for *Disclosure Duty* is a pooling equilibrium in pure strategies, in which patients will not collect information. The only Proper Equilibrium for *Perfect Privacy* is a separating equilibrium in pure strategies with full information acquisition. These two findings nicely parallel findings from more complex models of genetic testing and prevention behavior (see e.g. Bardey et al., 2014; Barigozzi and Henriet, 2011; Peter et al., 2014). For *Imperfect Privacy* we show that there exist, both, the separating equilibrium with complete information acquisition and the pooling equilibrium without information acquisition (as well as a proper mixed strategy equilibrium with incomplete information acquisition).[10]

Due to the existence of multiple equilibria (under *Imperfect Privacy)* our theoretical model does not provide clear guidance with respect to whether imperfect data privacy stops people from collecting personal information. Therefore, it is crucial to investigate which outcomes may result from actual behavior. Hence, we complement our theoretical analysis with a laboratory experiment. The participants of the laboratory experiment played a neutrally framed version of our two-player persuasion game. We parameterized the game such that insurers were ex ante willing to contract with unknown health types and implemented three different treatments reflecting the institutions described above. The experimental results show that behavior in *Perfect Privacy* and *Imperfect Privacy* almost coincides. Thus, imperfect data privacy does not stop

[10] While these results are derived by modelling patients and insurers as risk neutral and abstaining from modelling direct costs or benefits from testing, we show that these Proper Equilibria are robustness to common assumptions concerning risk aversion of patients and risk neutrality of insurers. Further, we discuss also the robustness of the different equilibria concerning costs and benefits from testing.

people from collecting personal information. Only under *Disclosure Duty*, information acquisition is reduced and contracting with unknown types becomes common.

The rest of this paper is structured as follows. In Section 2, we briefly review the related literature. In Section 3 we present our theoretical arguments. Section 4 encompasses detailed information about the experimental design, procedures, and results. The theoretical and empirical results are discussed in Section 5. We conclude with Section 6.

2 Related Literature

Our paper relates to two branches of literature. First, we contribute to behavioral and experimental approaches dealing with patients' behavior in the context of health economics.[11] Second, we enrich the more general literature on testing for quality information.

Most behavioral studies on patients' behavior have focused on prevention through the promotion of healthier lifestyles. In this respect randomized controlled trials have been used to study how dietary and smoking habits, cancer prevention, gym visits, vaccinations and doctoral visits can be affected by small nudges (Altmann and Traxler, 2014; Calzolari and Nardotto, 2011; Cox et al., 2010; Milkman et al., 2013; Rothman et al., 1993), commitment devices and/or monetary incentives (Acland and Levy, 2010; Augurzky et al., 2012; Babcock et al., forthcoming; Charness and Gneezy, 2009; Giné et al., 2010; John et al., 2011; Paloyo et al., 2013; Volpp et al., 2008). Our study also focuses on patients' behavior. In contrast to nudging and paying for patients' performance studies, our study focuses on how institutions (in form of different privacy regulations) shape patients' incentive structure and thereby affect their willingness to collect and disclose personal health data.

[11] For a study on physicians' reactions to different types of incentives, see e.g. Brosig-Koch et al. (forthcoming).

Therefore, we also contribute to the literature on the merits of privacy for testing and revealing quality information.[12] Testing for quality information has been studied theoretically in the context of insurance markets (see e.g. Bardey et al., 2014; Barigozzi and Henriet, 2011; Doherty and Thistle, 1996; Hoy and Polborn, 2000; Peter et al., 2014) and matching markets (see e.g. Caplin and Eliaz, 2003; Philipson and Posner, 1995).[13] The theoretical work by Barigozzi and Henriet (2011), Bardey et al. (2014) and Peter et al. (2014) relates closest to our approach as the authors also discuss the consequences of Disclosure Duty and Consent Law (Perfect Privacy) for testing and disclosure decisions in insurance markets. In contrast to our study, these studies explicitly focus on genetic testing and model testing as an informative action for the patient, that allows e.g. for better insurance choice or prevention effort. We follow the approach for STD testing and protection by Philipson and Posner (1995) and abstain from modelling explicit testing benefits for the patient in our simplified game of persuasion. Nevertheless, we obtain similar qualitative results for testing behavior under the different institutions. Also, we do provide a discussion on the robustness of our results with respect to explicit costs and benefits from testing. Further, we extend their work by introducing an institution in which patients face the risk of involuntary disclosure (*Imperfect Privacy*) and by providing empirical evidence from a laboratory experiment that tests the predictions of our theoretical model for three different privacy institutions.

[12] For early contributions to this discussion see Stigler (1980) and Posner (1981) as well as Hermalin and Katz (2006). Further, see also theoretical contributions based on Grossman (1981)'s and Milgrom (1981)'s idea of unraveling in markets with asymmetric information that model endogenous information acquisition (e.g. Brocas et al., 2012; Gentzkow and Kamenica, 2011; Perez-Richet, 2012). For an experiment on the revelation of quality types in a labor market context see also Benndorf et al. (2015).

[13] Our work relates further to the more general discussion about genetic testing (see Bardey and De Donder, 2013; Hoel and Iversen, 2002; Tabarrok, 1994).

3 Theory

3.1 The Model

Our theory builds on a simple game of persuasion which reflects the idea of an insurance market in which a patient (player 1) persuades an insurer (player 2) to contract by providing certified information about her health type. Player 2 can contract (match) with player 1 and both may benefit from the match. A match is always profitable for player 1. However, player 2's payoff depends on player 1's type. Player 1 can be a good (type G) or a bad type (type B). A match with a good type increases player 2's payoff. A match with a bad type decreases his payoff (e.g. costs for medical treatments to be paid by the insurer). A match results in payoff M for each player. However, if player 1 is a bad type, player 2 additionally incurs a loss of I.[14] We assume $M>0$, $I>0$, and $I>M$. The last assumption describes the fact that a match with a bad type decreases player 2's payoff. Let $0<b<1$ be the share of bad types in the population of players 1. Further, for the main model, we assume both players to be risk neutral. We discuss the robustness of our results with respect to risk aversion in subsection 3.2.1

Player 1 does not know her type ex-ante, but she can test and disclose her type to player 2 before player 2 decides on whether to match. Testing and disclosing is costless.[15] The action of testing (not testing) is denoted by T ($\bar{T}$). The action of voluntarily disclosing (not voluntarily disclosing) the test result to player 2 is denoted by D ($\bar{D}$). Let d_G, d_B be the probabilities that type G and type B voluntarily disclose their type after testing.

[14] We refrain from modeling a partial internalization of the loss of utility (from a match with a bad type) of player 2 by player 1. Nevertheless modelling this internalization as a loss of I' for player 1 does not change the model's predictions as long as for player 1 $I'<M$.

[15] We discuss the impact of explicit testing costs in subsection 3.2.2.

Player 2 can learn player 1's type only if player 1 had herself tested. After a test, player 1 might disclose her type voluntarily. However, player 2 might learn the test result although player 1 decided against disclosing with probability p. Therefore, $p = 1$ reflects *Disclosure Duty*, $p = 0$ reflects *Perfect Privacy* and $0 < p < 1$ reflects *Imperfect Privacy*. Note that the action of testing itself cannot be observed. Hence, if player 2 does not learn player 1's type, he also does not learn whether player 1 had herself tested or not. Let U (unknown) denote the fact that player 2 does not know player 1's type. X ($\bar{X}$) denotes player 2's decision to match (not to match) and s_i denotes the strategy of player i.

We are now ready to describe the existence of equilibria under the different privacy institutions. For all institutions, player 2 will match with an identified type G and will never match with an identified type B. Whether player 2 will match with an unidentified type U, depends on the data privacy institution (i.e. on p). In the following, we present equilibria in pure strategies for each institution separately followed by a short intuitive reasoning.[16]

Proposition 1 (Disclosure Duty)

a) For $p = 1$ and $M \leq bI$

$s_1 = T, s_1(G|T) = D, s_1(B|T) = d_B$ with $0 \leq d_B \leq 1$,

$s_2(G) = X,\ s_2(B) = \bar{X}$ and $s_2(U) = \bar{X}$

is a pure strategy equilibrium (complete information acquisition).

b) *For* $p = 1$ and $M \geq bI$

$s_1 = \bar{T}, s_1(G|T) = d_G$ with $0 \leq d_G \leq 1, s_1(B|T) = \bar{D}$,

$s_2(G) = X,\ s_2(B) = \bar{X}$ and $s_2(U) = X$

is a pure strategy equilibrium (no information acquisition).

Because all test results are revealed under *Disclosure Duty*, an unknown type has to be an untested player. The expected payoff of a match with an untested player is non-positive as long

[16] We relegate formal proofs of all propositions as well as the derivation of mixed strategy equilibria to the appendix.

as $M \leq bI$. Therefore, for $M \leq bI$ player 2 will not match with untested players and player 1 can only gain from testing. For $M \geq bI$ the expected payoff of a match with an untested player is non-negative. Therefore, player 2 will match with untested players and player 1 will not test.

Proposition 2 (Perfect Privacy)

a) For $p = 0$

$s_1 = T, s_1(G|T) = D, s_1(B|T) = d_B$ with $0 \leq d_B \leq 1$,

$s_2(G) = X,\ s_2(B) = \bar{X}$ and $s_2(U) = \bar{X}$

is a pure strategy equilibrium (complete information acquisition).

b) For $p = 0$ and $M \geq bI$

$s_1 = \bar{T}, s_1(G|T) = d_G$ with $0 \leq d_G \leq 1, s_1(B|T) = \bar{D}$,

$s_2(G) = X,\ s_2(B) = \ \bar{X}$ *and* $s_2(U) = X$

is a pure strategy equilibrium (no information acquisition)

If player 2 does not match with unknown types, it is worthwhile to test for player 1. Also, it will be worthwhile for player 1 to disclose her test result if the test reveals that she is of type G. Type B is indifferent whether or not to disclose her type. In turn, as everybody tests and type G discloses her type, player 2 will not match with unknown types (who are all of type B). Given player 2 matches with type G and unknown types U, player 1 is (in expectation) not better of when testing and hence does not deviate from her strategy of not testing.

Proposition 3 (Imperfect Privacy)

a) For $0 < p < 1$

$s_1 = T, s_1(G|T) = D, s_1(B|T) = d_B$ with $0 \leq d_B \leq 1$,

$s_2(G) = X,\ s_2(B) = \bar{X}$ and $s_2(U) = X$

is a pure strategy equilibrium (complete information acquisition).

b) For $0 < p < 1$ and $M \geq bI$

$s_1 = \bar{T}, s_1(G|T) = d_G$ with $0 \leq d_G \leq 1, s_1(B|T) = \bar{D}$,

$s_2(G) = X,\ s_2(B) = \bar{X}$ and $s_2(U) = X$

is a pure strategy equilibrium (no information acquisition).

The intuition for the equilibrium with complete information acquisition (3a) is the same as for (2a). The intuition for the equilibrium with no information acquisition (3b) is that given player 2 matches with type G and unknown types U, it is clearly worthwhile to forgo collecting information as long as data privacy is not guaranteed ($p>0$) because not collecting information prevents involuntary disclosure of being a bad type. If nobody tests, the set of untested players and the set of players of unknown types coincide and thus matching with unknown types will be worthwhile (or at least not harmful) for player 2 with $M \geq bI$.

In addition to the pure strategy equilibria there exist several mixed strategy equilibria in which information acquisition is incomplete. We relegate the derivation of these equilibria to appendix B but report the existence of these equilibria along with the proper pure strategy equilibria in Figure 1.

3.2 Robustness: Risk aversion, costs and benefits from testing and equilibrium refinements

In this section we discuss the robustness of the different equilibria with respect to our assumption of risk neutral players. Thereafter, we offer a brief discussion of the robustness of the different equilibria with respect to the introduction of explicit costs or benefits from testing. Finally, we show which of the derived equilibria are *Proper Equilibria* (Myerson, 1978).

3.2.1 Risk aversion

For all institutions, equilibria without information acquisition and incomplete information acquisition do not exists if player 2 (the insurer) is sufficiently risk averse because in this case player 2 will only match with identified good types. The equilibrium with full information acquisition holds also for risk averse players, since player 2 chooses the save option (matching with tested good types only) in equilibrium and player 1 has, in equilibrium, nothing to lose by playing the "lottery of testing".[17]

3.2.2 Costs and benefits from testing

We abstained from modeling costs and benefits explicitly. In this section, we briefly discuss how the introduction of costs and benefits affects the existence of the different equilibria. We will consider both, costs and benefits from testing that do not depend on the outcome of the test (costs of the test) and costs that depend on the testing outcome (psychological costs).[18]

First, it is clear that pure strategy equilibria in which people decide to test and reveal will still exist, if we introduce benefits from testing (both outcome dependent and outcome independent benefits), because benefits make testing even more attractive. Second and analogously, pure strategy equilibria without information acquisition and matching with unknown types will still exist, if we introduce costs from testing (for both types of costs). Third, it can be shown that the equilibria with full information acquisition also hold with explicit costs from testing as long as the expected gains from testing outweigh the costs. Equilibria with no information acquisition still hold for $p > 0$ as long as the benefits from testing for Player 1 are smaller or equal to the expected loss of a match due to the revelation of a bad test outcome. However, under *Perfect Privacy* ($p = 0$), the equilibrium without information acquisition does not hold as soon as there are benefits from testing. Player 1 will test because collecting benefits from testing is riskless, if privacy is guaranteed.

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[17] Assuming a risk neutral insurer but a risk averse consumer (as Doherty and Thistle, 1996), equilibria with complete information or no information still exist for all institutions. Equilibria with incomplete information acquisition exist only for *Disclosure Duty* and *Imperfect Privacy*.

[18] By doing so we implicitly deal with benefits from knowing to be the good type (which are in our model mathematically equivalent to costs from knowing to be the bad type) and costs from not knowing to be the good type (which are mathematically equivalent to benefits from knowing to be the bad type).

3.2.3 Equilibrium refinements

We derive several equilibria for each institutional setting. In this subsection we briefly discuss whether the number of equilibria may be reduced by applying the equilibrium refinement concept of *Proper Equilibrium*. The notion of *Proper Equilibrium* has been introduced by Myerson (1978) and is a further refinement of Selten (1975)'s *Trembling-Hand Perfect Equilibrium*. *Proper Equilibria* consider the possibility that players play also non-equilibrium strategies with positive but very small probability such that decision errors are possible. The main idea of the *Proper Equilibrium* concept is that the likelihood of an error depends on the costs of making the error, i.e. making a more costly error can never be more likely than making a less costly error.

Applying this idea to our propositions it can be shown that for *Perfect Privacy* ($p = 0$) the equilibrium without and incomplete information acquisition are no Proper Equilibria. All equilibria we derived for *Imperfect Privacy* and *Disclosure Duty* remain. Figure 1 summarizes these findings. The figure illustrates that privacy institutions do not matter for testing if $M<bI$. Here only equilibria with complete information acquisition are possible. Since $M=bI$ is a very unlikely assumption, we focus on the case $M>bI$. Here, were find a unique *Proper Equilibrium* with no information acquisition in *Disclosure Duty,* and a unique *Proper Equilibrium* with complete information acquisition in *Perfect Privacy.* However, the theory yields multiple *Proper Equilibria* for *Imperfect Privacy* , i.e. the model does not provide a clear prediction with respect to the question whether *Imperfect Privacy* stops people from collecting information. Therefore, we test our model's predictions in an experiment that allows us to investigate whether behavior under *Imperfect Privacy* rather coincides with behavior under *Perfect Privacy* or *Disclosure Duty*.

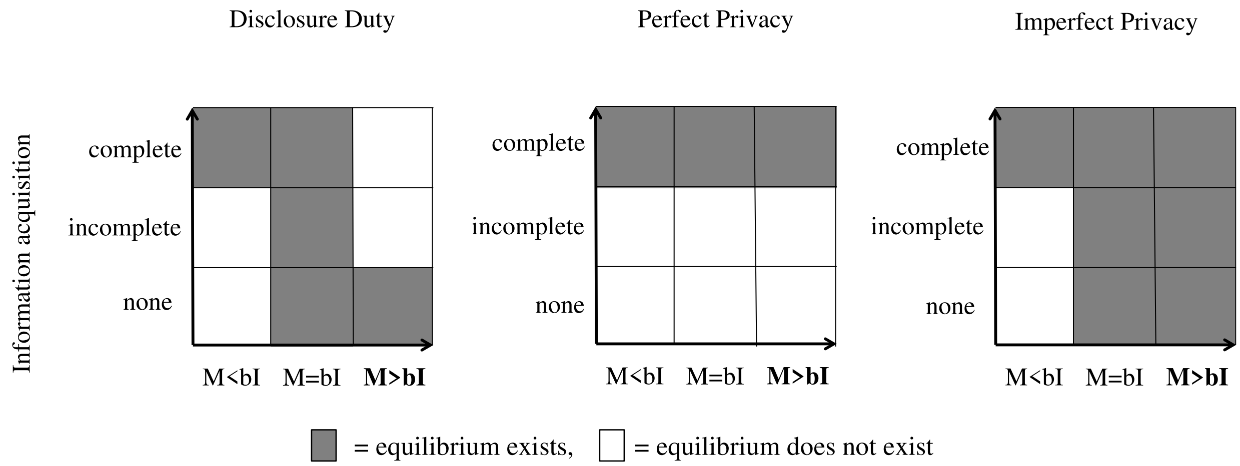

Figure 1: Proper equilibria in the different privacy institutions

4 Experiment

At the beginning of the experiment subjects were informed that the experiment consists of two independent parts and knew that one part was determined to be payoff relevant at the end of the experiment. Subjects received the instructions for the second part only after they finished the first part.

4.1 Experimental design for Part 1 (one-shot)

We chose the following parameter values for the experiment which were all common knowledge: The share of bad types *B* within players 1 was $b = 1/3$. A match yielded 10 points for both players (*M=10*). A match with type *B* additionally decreased player 2's payoff by 15 points (*I=15*). At the beginning of the experiment, each player received an endowment of 10 points to prevent negative payoffs. Half of the participants were randomly assigned to the role of player 1 and half to the role of player 2. Then, player 1 and 2 were randomly assigned to a pair. Player 1 decided whether to test for her type (and whether to disclose the test result). Testing was costless. Player 2 (potentially) learned the test result and decided whether to match.

We implemented three values of p as treatment conditions in a between-subjects design: $p = 1$ (*Disclosure Duty*), $p = 0$ (*Perfect Privacy*) and $p = 0.5$ (*Imperfect Privacy*). Remember that after a test, the test result was displayed to both players automatically in *Disclosure Duty* whereas in *Perfect Privacy*, player 1 first learned the test result and then decided whether to display the result to player 2. In *Imperfect Privacy,* after a test, player 1 first learned the test result and second decided whether to display the result to player 2. However, if player 1 decided to test she ran the risk of involuntary disclosure of the test result. If a player 1 had decided to test but not to transfer the information to the other player, a random device determined whether the test result was, nevertheless, shown on player 2's screen.[19] Note that player 2 only received information about the type of player 1 but not about whether or not this information was voluntarily revealed. Disclosing test results was costless and the test result displayed to both players was true in all treatments.[20] As in our theoretical framework, the choice of whether or not to undertake a specific test was a one shot decision for three reasons. First, specific tests (such as genetic tests) are usually not taken repeatedly. Second, taking a test once is sufficient that the information created by the test can be assessed by others (e.g. insurers). Third, the decision to buy a specific insurance, e.g. disability insurance, is usually non-repeated.

4.2 Experimental design for Part 2 (repeated)

To control for potential decision errors and learning, we added a second part to the experiment, in which subjects decided in ten periods whether or not to test (and disclose) or match. To exclude individual reputation building across periods and parts, we used a perfect stranger design (i.e. no

[19] One randomly selected participant rolled a six-sided die to determine whether a test result was involuntarily displayed (depending on whether the number was odd or even). The participant was monitored and announced the number publicly.

[20] For a discussion on imperfect testing devices see e.g. Caplin and Eliaz (2003) or Rosar and Schulte (2010) and more recently Schweizer and Szech (2013).

participant interacted with the same person more than once and this was common knowledge for all participants).

4.2 Experimental Procedures

We computerized the experiment using z-Tree (Fischbacher, 2007). Each player sat at a randomly assigned and separated computer terminal and was given a copy of written instructions.[21] The experiment was neutrally framed.[22] A set of control questions was provided to ensure that participants understood the game. If any participant repeatedly failed to answer correctly, the experimenter provided an oral explanation. No form of communication between the players was allowed during the experiment. We conducted ten sessions at the LakeLab (University of Konstanz, Germany) in June 2015 with a total number of 258 participants.[23] We recruited participants from the local subject pool using the online recruiting tool ORSEE (Greiner, 2004). In all treatments participants decided in one role, either as player 1 and or player 2 (and kept the role for the whole experiment). To avoid testing out of general curiosity, players were informed ex ante that they will learn their type ex post, at the end of the experiment. Procedures and parameters were common knowledge. Our experiment lasted 1 hour. 10 points were equivalent to 6 euros. Participants in our experiment received a 4 euro show-up fee and earned 13.60 euros on average ($15.23 at that point in time). Subjects also answered a short post-experimental questionnaire on their socio-economic background and their risk attitudes.

[21] A copy of translated instructions can be found in appendix C.

[22] We did not use the term patient or insurer or expressions such as “good” or “bad”. Participants acted as player 1 or 2 and player 1 was either of type A or B.

[23] $N_{Perfect\ Privacy} = 76$, $N_{Imperfect\ Privacy} = 102$, $N_{Disclosure\ Duty} = 80$.

4.3 Experimental Results

4.3.1 Testing, disclosing and matching (Part 1: one-shot)

Figure 2 presents testing frequencies for all treatments in Part 1. Testing in *Perfect Privacy* is significantly more likely than in *Disclosure Duty* (χ^2-test, p-value = 0.001). Also, testing in *Imperfect Privacy* is significantly more likely than in *Disclosure Duty* (χ^2-test, p-value = 0.001). Testing frequencies in *Perfect Privacy* and *Imperfect Privacy* do not significantly differ (χ^2-test, p-value = 0.631). Hence, only if data loss is certain, a significant share of players stops collecting information. We summarize this finding in Result 1.

Result 1 Testing frequencies in *Perfect Privacy* and *Imperfect Privacy* are higher than in *Disclosure Duty*. Testing frequencies in *Perfect Privacy* and *Imperfect Privacy* do not differ.

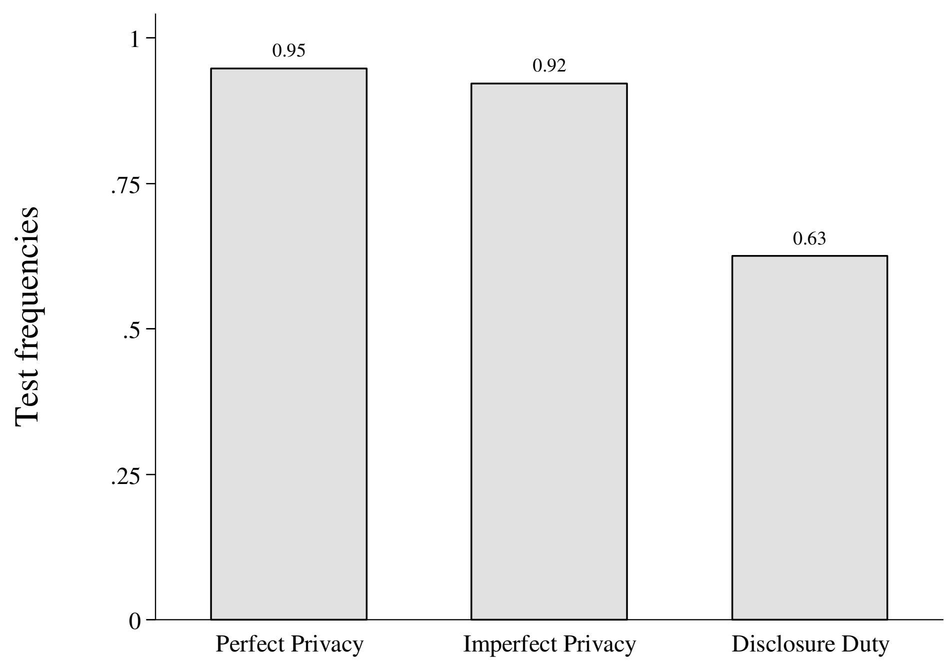

Figure 2: Test frequencies across treatments

Figure 3 shows that almost all tested good types disclosed their type in *Perfect Privacy* and *Imperfect Privacy*,[24] whereas voluntary disclosure of bad types is rare.[25] Following, almost all players in *Perfect Privacy* and (almost all players in) *Imperfect Privacy* who did not disclose their type, are tested type *B* or untested players.

Result 2 Disclosure behavior in *Perfect Privacy* and *Imperfect Privacy* does not differ. Good types disclose their type, bad types do not.

Because players 1 test and good types disclose their type in *Imperfect Privacy* and *Perfect Privacy,* but fewer players test in *Disclosure Duty,* we should observe fewer matches with unknown types in *Imperfect Privacy* and *Perfect Privacy* compared to *Disclosure Duty*.

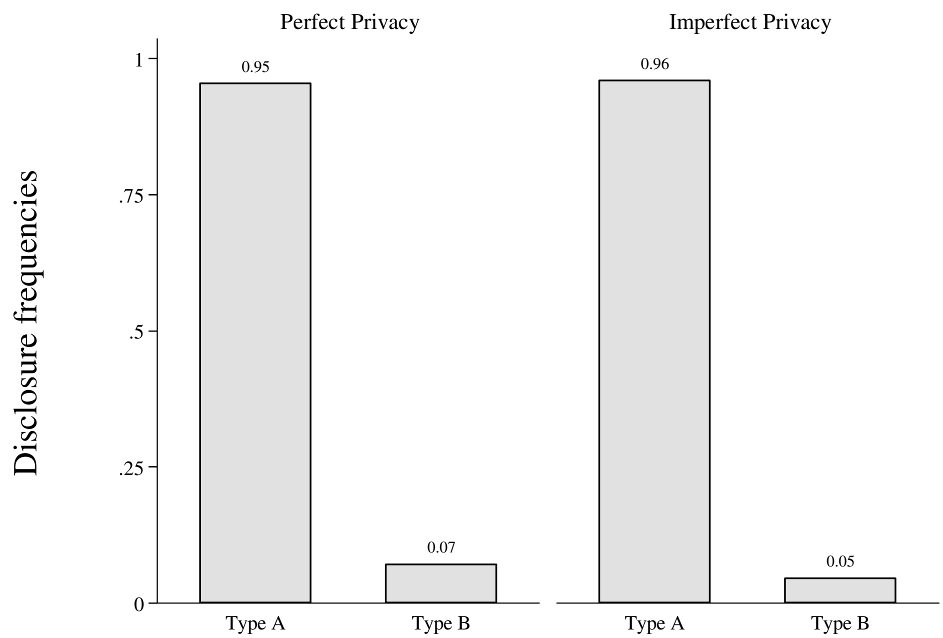

Figure 3: Disclosure frequencies when tested (in Perfect Privacy and Imperfect Privacy)

[24] We cannot reject the hypothesis that disclosure behavior of tested good types is identical in *Privacy* and *Imperfect Privacy* (Fisher's exact test, p-value = 0.926)

[25] We cannot reject the hypothesis that disclosure behavior of tested bad types is identical in *Perfect Privacy* and *Imperfect Privacy* (Fisher's exact test, p-value = 0.740)

Indeed, as Figure 4 shows, this is exactly what we find: In *Disclosure Duty* 73 percent of players facing an unknown type decide to match whereas only 31 percent do so in *Perfect Privacy* (Fisher's exact test, p-value = 0.001) as well as in *Imperfect Privacy* (Fisher's exact test, p-value = 0.014). Finally, subjects rarely make errors when matching with disclosed types. Out of 65 disclosed good types 63 received a match. All 17 disclosed bad types received no match. We summarize these findings in Result 3.

Result 3 Matching with unknown types is not more likely in *Imperfect Privacy* than in *Perfect Privacy* but significantly more likely in *Disclosure Duty.*

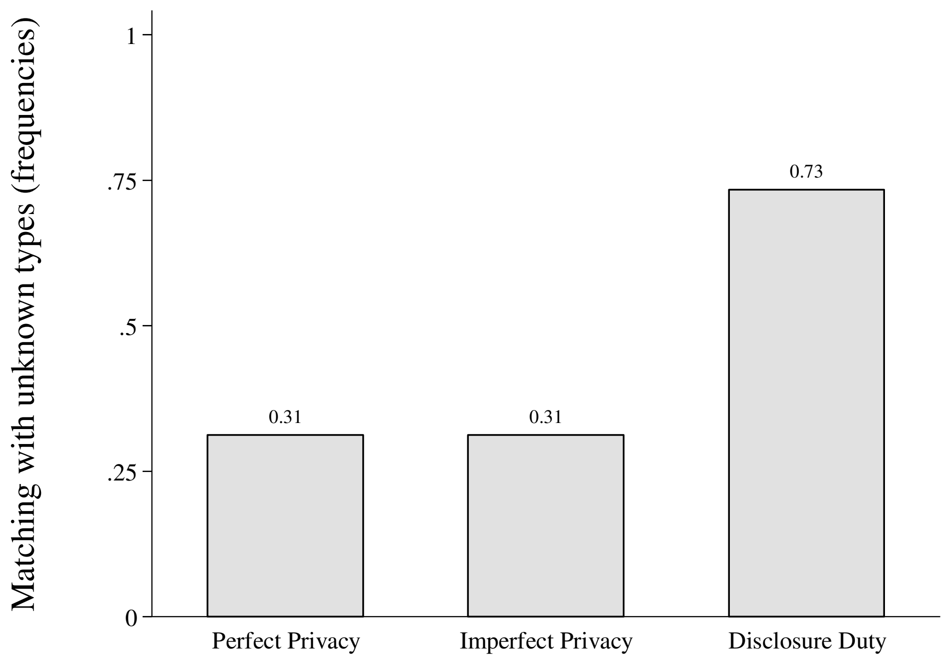

Figure 4: Matching with unknown type
(# subjects matching with an unknown type / # subjects facing an unknown type)

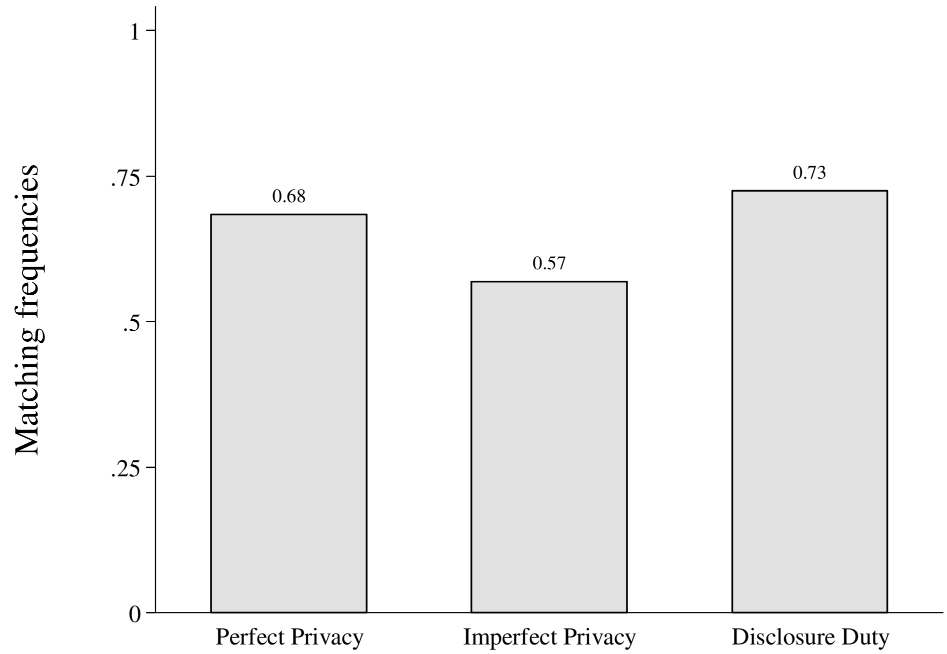

Figure 5: Total frequencies of matches

Finally, we analyze whether efficiency varies across the different privacy institutions, and in particular shed light on whether efficiency in *Imperfect Privacy* differs from efficiency in *Perfect Privacy*. We measure efficiency by the total frequency of matches (see Figure 5) as each match generates a surplus. Since information acquisition and transmission does not significantly differ in the two privacy institutions and people rarely make errors when matching with disclosed types, differences in efficiency between *Imperfect Privacy* and *Perfect Privacy* are expected to be small. If at all we should expect slightly fewer matches (and thus lower efficiency) in *Imperfect Privacy*, because insurers can identify some tested but undisclosed bad health types in *Imperfect Privacy,* given data is disclosed involuntarily. Indeed, we find that matching tends to be less likely in *Imperfect Privacy* compared to *Perfect Privacy* (57 vs. 68 percent) but does not differ significantly (χ^2-test, p-value = 0.267). *Disclosure Duty* yields the highest level of efficiency, since it results in the most matches but also fails to differ significantly from the other two institutions (*Disclosure Duty* vs. *Imperfect Privacy,* χ^2-test, p-value = 0.124 and *Disclosure Duty vs. Perfect Privacy,* χ^2-test, p-value = 0.693).

Result 4 Efficiency levels between *Imperfect Privacy* and *Perfect Privacy* do not significantly differ.

4.3.2 Errors and learning (Part 2: repeated)

In this section we briefly report on the behavior in the second part of the experiment, in which we repeated the first experiment for 10 periods. Figure 6 clearly confirms Result 1. Testing frequencies between *Perfect Privacy* and *Imperfect Privacy* do not differ. Testing frequencies are significantly lower in *Disclosure Duty* compared to both other institutions.[26] There is no time trend in testing frequencies in *Perfect Privacy* or *Disclosure Duty*. In *Imperfect Privacy*, we observe a slightly positive time trend in testing frequencies.[27] Further we also confirm Result 2, i.e. disclosure behavior between *Perfect* and *Imperfect Privacy* does not differ in the repeated setting (see Figure 7).[28]

[26] Calculating the individual average frequencies of testing during the ten rounds and comparing these frequencies across treatments using a Mann-Whitney-U-test yields the following p-values: *Perfect Privacy* vs. *Imperfect Privacy,* p = 0.271, *Perfect Privacy* vs. *Disclosure Duty,* p = 0.000, *Imperfect Privacy* vs. *Disclosure Duty* p = 0.000.

[27] Using regression analyses, the positive trend in testing in *Imperfect Privacy* is also statistically significant.

[28] Calculating the individual average frequencies of disclosure when tested during the ten rounds and comparing these frequencies across treatments using a Mann-Whitney-U-test yields the following p-values: *Perfect Privacy* vs. *Imperfect Privacy* for Type A, p = 0.308, *Perfect Privacy* vs. *Imperfect Privacy* for Type B, p = 0.505.

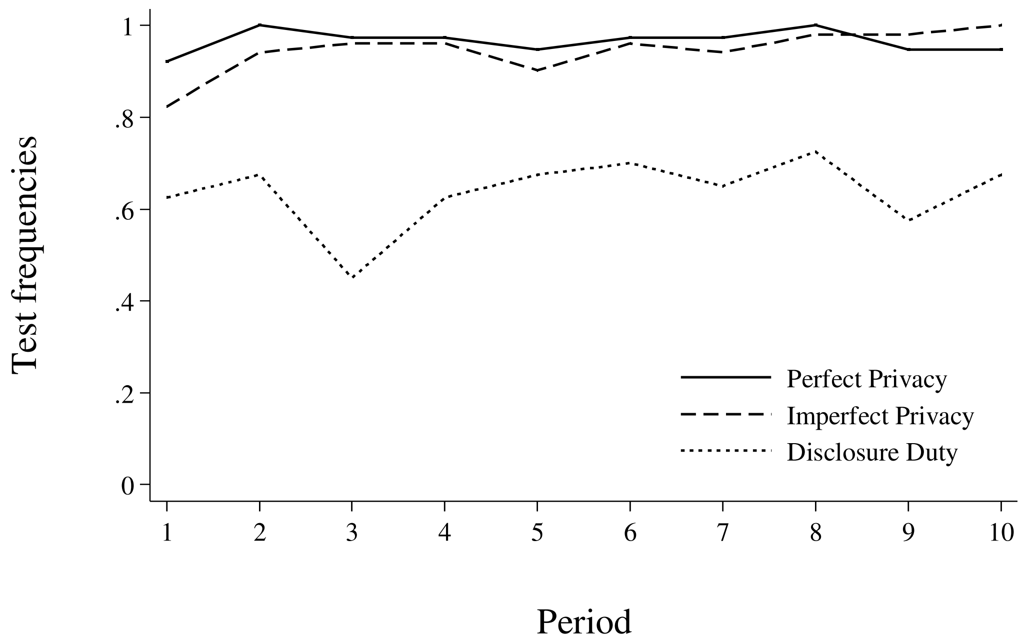

Figure 6: Test frequencies over periods across treatments

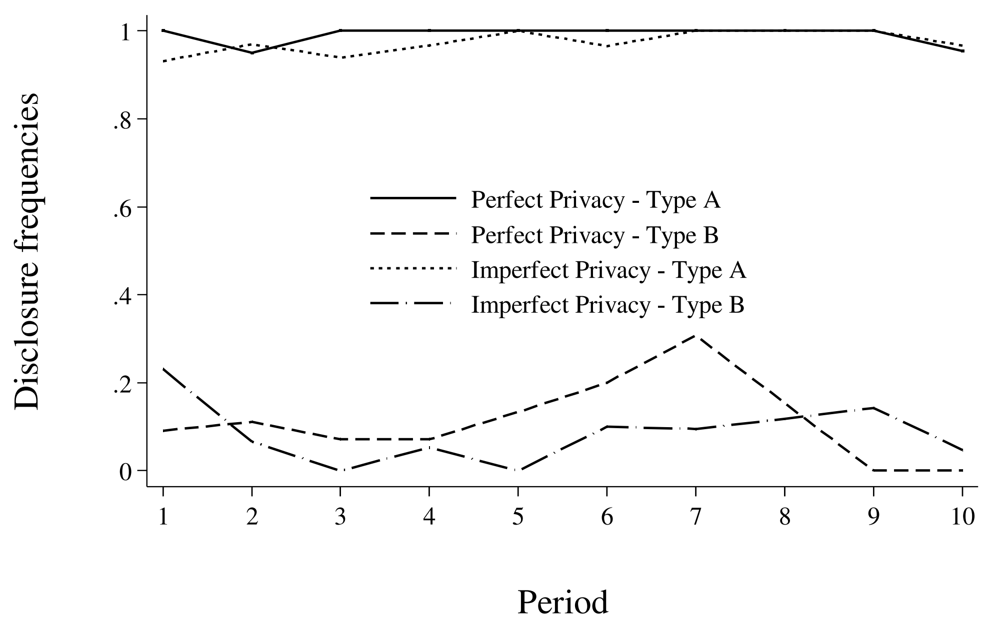

Figure 7: Disclosure frequencies when tested over periods (in Perfect Privacy and Imperfect Privacy)

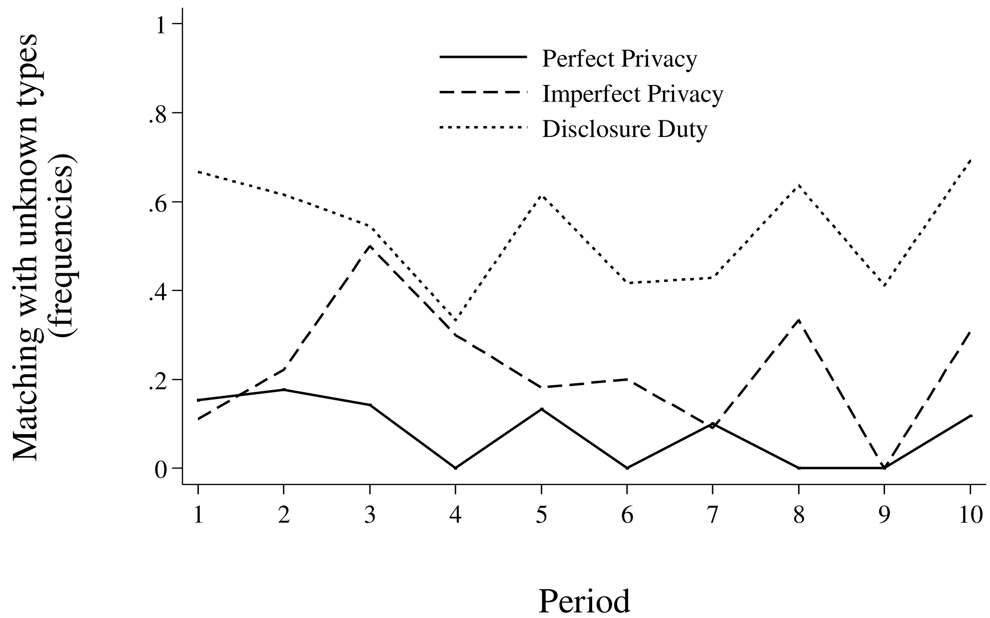

Figure 8: Matching with unknown type over periods across treatments

Similarly, Figure 8 confirms Result 3, i.e. matching with unknown types is more likely in *Disclosure Duty* than in *Perfect Privacy* and *Imperfect Privacy*.[29] We do not observe any time trend in matching with unknown types.[30] Thus, while some participants try out different strategies in the first periods of the second part of the experiment, our findings from the one-shot environment are robust on the aggregate level.

5 Discussion

We study theoretically and experimentally whether imperfect data privacy stops people from collecting personal information about their health type. Our theory does not provide a clear answer to this question, as it allows for multiple equilibria if the privacy institution is imperfect.

[29] Calculating the individual average frequencies of matching with an unknown type during the ten rounds and comparing these frequencies across treatments using a Mann-Whitney-U-test yields the following p-values: *Perfect Privacy* vs. *Imperfect Privacy,* $p = 0.115$, *Perfect Privacy* vs. *Disclosure Duty,* $p < 0.001$, *Imperfect Privacy* vs. *Disclosure Duty* $p < 0.001$.

[30] Using regression analyses (available on request), there is no significant trend in the matching decisions in any of the three treatments.

The empirical results from our laboratory experiment show that imperfect privacy does not stop people from collecting information. Information acquisition, disclosure behavior and efficiency in *Imperfect* and *Perfect Privacy* almost coincide. Two possible reasons may explain why behavior does not differ in the two privacy institutions: First, at the testing stage in *Imperfect Privacy* people may simply not take into account the consequences of involuntary disclosure. However, this seems to be unlikely, as testing was frequently used even in the repeated setting in which participants had enough time to experience the consequences of different information acquisition and disclosure strategies. Second, people may expect that many insurers are likely to only match with identified good health types (even if privacy is imperfect). As only 31 percent of our participants matched with unknown types, it was (in expectation) indeed optimal to test in *Imperfect Privacy.*

Our results provide insights relevant to policy makers. From a perspective of equal opportunities for good and bad health types, a social planner might be interested in maximizing the number of insured persons. For this goal, *Disclosure Duty* performs best. However, if we interpret the simple game of persuasion as a reduced form of a matching market in which (un)infected persons look for sexual partners, a policy maker may be interested in maximizing the number of tests. Instead of modeling two potential partners in a symmetric way, our game simplifies the decision framework such that one partner always wants to match but might be infected (player 1) whereas the other is not infected and only wants to match with healthy partners (player 2). A policy maker interested in maximizing the number of tests and thereby eventually minimizing the frequency of infections (mismatches) will prefer *Perfect Privacy*.[31] As

[31] More testing eventually reduces the number of mismatches. Engelhardt et al. (2013) for instance argue that on internet platforms for semi-anonymous encounters, provision of information about the own HIV status might result

in *Perfect Privacy,* almost all players in *Imperfect Privacy* test and the good types disclose their test result whereas in *Disclosure Duty* the most matches with unknown types occur. [32]

Finally, we want to note that behavior in the experiment corresponds to qualitative differences of our theoretical predictions (more information acquisition and fewer matches with unknown types in *Perfect Privacy* than *Disclosure Duty*). However, actual behavior does not coincide with the point predictions of the model. While testing frequencies in *Perfect Privacy* and *Imperfect Privacy* almost perfectly correspond to the theoretical prediction, testing is observed far too frequently in *Disclosure Duty.* Such behavior may be driven by social preferences, assumptions about other players' risk aversion, curiosity or simple decision errors. Our design does not allow distinguishing between social preference concerns and beliefs about other players' risk aversion.[33] Curiosity as well as decision errors are, however, unlikely to explain frequent testing. First, all subjects knew that they would learn their own type at the end of the experiment (irrespective of their testing decision). Second, the results from the second part of the experiment do not indicate any learning patterns in *Disclosure Duty*. Further, we observe more matches with unknown types in *Perfect Privacy* and *Imperfect Privacy* than predicted in the proper equilibrium with complete information acquisition. Frequent matching with unknown types may also be a result of efficiency concerns, since a match always increased the total surplus. Future research may try to further disentangle which of the reasons discussed above explain the observed behavior.

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in a directed search and reduce the transmission rate by separating the uninfected and infected, e.g. through the use of condoms.

[32] We carefully note that in the context of HIV testing, social preferences may matter strongly and many people may test and report their result, irrespective of the institutional setup.

[33] Note that the experimentally validated survey measure on own risk attitudes (see Dohmen et al., 2011) from our post-experimental questionnaire does not significantly relate to testing behavior.

6 Conclusion

The behavioral literature on preferences for privacy has so far focused on information transmission (see for instance Acquisti et al., 2013; Benndorf and Normann, 2014; Beresford et al., 2012; Grossklags and Acquisti, 2007; Hall et al., 2006; Huberman et al., 2005; Schudy and Utikal, 2014; Tsai et al., 2011). In this paper, we argue that it is also important to investigate how different privacy regulations affect the willingness to collect personal health data. Studying the impact of privacy regulations in the context of health markets is crucial, because information about personal health characteristics has to be generated through the help of third parties (e.g. doctors). If data privacy cannot be guaranteed, people face the risk that their test results are disclosed involuntarily. In turn, people may refrain from testing. The behavioral results from our laboratory experiment suggest, however, that people collect information irrespective of whether data privacy is perfect or imperfect - even in an abstract environment that renders the potential consequences of involuntary disclosure salient.

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Appendix A – Proofs of propositions 1 to 3

We provide proofs of propositions 1 to 3 for risk-neutral players. However, note that the propositions also hold as long as expected utility of matches with unknown types are sufficiently high or the utility function is not too concave.

Note that π_i denotes player i's expected payoff.

Proof of Proposition 1

a) Assume player 2 will not match with unknown types $s_2(G) = X$, $s_2(B) = \bar{X}$, and $s_2(U) = \bar{X}$. If $p = 1$, player 1 will test, i.e. $s_1 = T$, because $\pi_1(T) = (1-b)M > \pi_1(\bar{T}) = 0$. Player 2's best response is $s_2(G) = X$, $s_2(B) = \bar{X}$, and $s_2(U) = \bar{X}$ if $M \leq bI$, because $\pi_2(X|G) = M > 0$, $\pi_2(X|B) = M - I < 0$, and $\pi_2(X|U) = M — bI \leq 0 \Leftrightarrow M \leq bI$.

b) Assume player 2 will match with unknown types $s_2(G) = X$, $s_2(B) = \bar{X}$, and $s_2(U) = X$. If $p = 1$, player 1 will not have herself tested, i.e. $s_1 = \bar{T}$, since a tested player 1 will automatically be disclosed and in case of a bad test result, player 1 would not receive a match. Player 2's best response is $s_2(G) = X$, $s_2(B) = \bar{X}$, and $s_2(U) = X$ if $M \geq bI$ because $\pi_2(X|G) = M > 0$, $\pi_2(X|B) = M - I < 0$, and $\pi_2(X|U) = M — bI \geq 0 \Leftrightarrow M \geq bI$.

Proof of Proposition 2

a) Assume player 2 will not match with unknown types $s_2(G) = X$, $s_2(B) = \bar{X}$, and $s_2(U) = \bar{X}$. If $p < 1$, player 1 will disclose her type after a good test result $s_1(G|T) = D$ because $\pi_1^G(\bar{D}|T) = 0 < \pi_1^G(D|T) = M$. After a bad test result player 1 is indifferent whether to disclose her type $s_1(B|T) = D$ with $0 \leq d_B \leq 1$ because $\pi_1^B(\bar{D}|T) = 0 =$

$\pi_1^B(D|T)$. Player 2's best response is $s_2(G) = X$, $s_2(B) = \bar{X}$, $s_2(U) = \bar{X}$ because $\pi_2(X|G) = M > 0$, $\pi_2(X|B) = M - I < 0$, and $\pi_2(X|U) = M — I \leq 0$ for all M.

b) Assume p=0. Assume further that player 1 will never test and player 2 will match with unknown types. Clearly, player 1 cannot gain from testing if player 2 matches with unknown types. The same holds for player 2's matching strategy $s_2(G) = X$, $s_2(B) = \bar{X}$, and $s_2(U) = X$ because $\pi_2(X|G) = M > 0$, $\pi_2(X|B) = M - I < 0$, and $\pi_2(X|U) = M — bI \geq 0 \Leftrightarrow M \geq bI$.

Proof of Proposition 3

a) Analogous to proposition 2a.

b) Assume player 2 will match with unknown type, i.e. $s_2(G) = X$, $s_2(B) = \bar{X}$, and $s_2(U) = X$. If $0 < p < 1$, a tested player 1's best response will be $s_1(G) = d_G \; with \; 0 \leq d_G \leq 1$ because $\pi_1^G(\bar{D}|T) = M = \pi_1^G(D|T)$ and $s_1(B|T) = \bar{D}$ because $\pi_1^B(\bar{D}|T) = (1-p)M > \pi_1^B(D|T) = 0$. It follows that $s_1 = \bar{T}$. Player 2's best response is $s_2(G) = X$, $s_2(B) = \bar{X}$, and $s_2(U) = X$ if $M \geq bI$ because $\pi_2(X|G) = M > 0$, $\pi_2(X|B) = M - I < 0$, and $\pi_2(X|U) = M — bI \geq 0 \Leftrightarrow M \geq bI$.

Appendix B – Incomplete information acquisition (mixed strategy equilibria)

Let *m* denote the probability that player 2 matches with an unknown type and *t* the probability that player 1 tests.

Incomplete information acquisition under Disclosure Duty

For $p = 1$ and $M = bI$.

$s_1 = t \in (0,1),\ s_1(G|T) = D, s_1(B|T) = \overline{D}$

$$s_2(G) = X,\ s_2(B) = \overline{X},\ \ s_2(U) = m = 1 - b$$

is a mixed strategy equilibrium.

Proof

Assume $s_2(U) = m = 1 - b$. Player 1 is indifferent between testing and not testing because $\pi_1(T) = (1 - b)M = \pi_1(\overline{T}) = mM$. Player 2 is indifferent between matching and not matching with unknown types because $\pi_2(X|U) = M - bI = 0 \Leftrightarrow M = bI$.

Incomplete information acquisition under Perfect Privacy

For $p = 0$ and $M > bI$

$s_1 = t \in \left(0, \frac{M - bI}{d_G M(1 - b)}\right),\ s_1(G|T) = d_G\ with\ 0 \le d_G \le 1, s_1(B|T) = \overline{D}$

$$s_2(G) = X,\ s_2(B) = \overline{X},\ \ s_2(U) = X$$

is a mixed strategy equilibrium.

Proof

If player 2 matches with unknown types, a tested good type is indifferent whether to disclose her type, i.e. $s_1(G|T) = d_G\ with\ 0 \le d_G \le 1$ and indifferent whether to test as long as player 2 matches with unknown types. Player 2 matches with unknown types if

$\pi_2(X|U) = M - \frac{b}{b+(1-t)(1-b)+t(1-d_G)(1-b)} I \geq 0 \Leftrightarrow t \leq \frac{M-bI}{d_G M(1-b)}$ and $M > bI$.

The left side of the equation derives from the fact that the fraction of undisclosed players consists of all players with Type B, untested players with Type A, and tested but undisclosed players with type A.

Incomplete information acquisition under Imperfect Privacy

For $0 < p < 1$ and $M \geq bI$

$$s_1 : t = \frac{M - bI}{pbM + M - bM - pbI},\ s_1(G|T) = D, s_1(B|T) = \overline{D}$$

$$s_2(G) = X,\ s_2(B) = \overline{X},\ \ s_2(U) = m = \frac{1-b}{1-b(1-p)}$$

is a mixed strategy equilibrium.

Proof

Assume $s_2(U) = m$ with $0 \leq m \leq 1$. If $0 < p < 1$, player 1 is indifferent whether to test as long as $s_2(U) = m = \frac{1-b}{1-b(1-p)}$. For player 2 a match with an unknown player yields:

$\pi_2(X|U) = M - \frac{(1-t)+t(1-p)}{(1-t)+t(1-p)b} bI = 0 \Leftrightarrow t = \frac{M-bI}{pbM+M-bM-pbI}$ and $M \geq bI$.

The left side of the equation derives from the fact that the fraction of undisclosed players consists of *1-t* untested players and *t(1-p)b* tested but undisclosed players with type B.

Appendix C – Instructions

One-shot experiment (translated from German)

We cordially welcome you to this economic experiment. In this experiment, your decisions and possibly other participants' decisions will influence your payoff. It is therefore important that you read these instructions carefully. For the entire experiment it is not allowed to communicate with other participants. If you have questions, please have a second look at the instructions. If you then still have questions, please raise your hand. We will then come to you and answer your question in private. Today's experiment consists of two independent parts (i.e. neither your decisions nor other participants' decisions from Part 1 are relevant for your or other participants' payoff in Part 2. Also, in Part 2 you will not interact with the same participant as in Part 1.) Both parts are equally likely to be payoff relevant. Which part will be payoff relevant will be determined after Part 2. The participant with seat number 12 will roll a six-sided die. If the die shows a ⚀, ⚁, or ⚂ Part 1 will be payoff relevant. If the die shows a ⚃, ⚄, or ⚅, Part 2 will be payoff relevant. Your payoff in the experiment will be calculated in points and later converted into euros. The points you achieve in the payoff relevant part will be converted to Euros and paid out at the end of the experiment. The exchange rate we will use is **10 points = 6 Euros.** On the following pages we will explain the procedures of Part 1. All participants received the same instructions. You will receive the instructions for Part 2 shortly after Part 1 has ended. Before the experiment starts, we will summarize the procedures verbally. After Part 2 we kindly ask you to answer a short questionnaire.

The Experiment

Summary

In this experiment two participants (participant 1 and participant 2) will be randomly matched. Whether you are a participant 1 or 2 will be randomly determined. As soon as the experiment starts the computer screen shows you whether you are participant 1 or 2. Each of the two participants receives 10 points.

Participant 1 is either a type A or type B. Whether participant 1 is a type A or type B depends on chance. For each participant 1 the probability of being a type A is exactly 2/3 (or 66.66%). The probability of being a type B for participant 1 is exactly 1/3 (or 33.33%). Participant 2 has no special type.

Participant 2 decides whether he would like to interact with participant 1. If no interaction takes place, points do not change. An interaction changes both participants' points.

- An interaction yields additional 10 points for participant 1.
- How an interaction affects participant 2 depends on participant 1's type. If participant 1 is a type A, participant 2 receives additional 10 points. If participant 1 is a type B, participant 2's points are reduced by 5 points.
- If there is no interaction, points do not change.

Procedure in detail

- One participant 1 and one participant 2 will be randomly assigned to each other. Participant 1 as well as participant 2 receive 10 points. Participant 1 does not know whether he is of type A or of type B. Participant 2 also does not know participant 1' type.
- Participant 1 decides whether she wants to learn her type.
- [This bullet point was only included in *Perfect Privacy*]

  If participant 1 has decided to learn her type, she decides whether to inform participant 2. **Please note**: If participant 1 knows her type and decided to inform participant 2, participant 2 will learn participant 1's true type. If participant 1 knows her type but did not inform participant 2, participant 2 will not learn participant 1's type. If participant 1 does not know her type, participant 2 will also not learn participant 1's type. If participant 2 does not learn participant 1's type, she will also not learn whether participant 1 herself knows her type. If participant 2 learns participant 1's type, he also knows that participant 1 knows her type.

- [This bullet point was only included in *Imperfect Privacy*]

If participant 1 decided to learn his type, she decides whether to inform participant 2 about her type. If participant 1 decided to learn her type, but does not inform participant 2, a random mechanism determines whether player 2 learns player 1's type nevertheless. In this case player 2 learns player 1's type with a probability of 50%.

Please note: If participant 1 knows her type and decided to inform participant 2, participant 2 will learn participant 1's true type. If participant 1 knows her type but did not inform participant 2, participant 2 will learn participant 1's type with a probability of 50%. In both cases participant 2 does not know whether he was informed about the type randomly or directly by participant 1. In all other cases, participant 2 does not receive any information about participant 1's type, i.e. if participant 1 does not know her type, participant 2 will also not learn participant 1's type. If participant 2 does not learn participant 1's type, he will also not learn whether participant 1 knows her type. If participant 2 learns participant 1's type, he also knows that participant 1 knows her type.

- [This bullet point was only included in *Disclosure Duty*]

If participant 1 decides to learn her type, participant 2 will learn participant 1's type too**.**

Please note: If participant 1 knows her type, participant 2 will also learn participant 1's true type. If participant 1 does not know her type, participant 2 does not receive any information about participant 1's type, i.e. if participant 1 does not know her type, participant 2 will also not learn participant 1's type. If participant 2 does not learn participant 1's type, he will also not learn whether participant 1 knows her type. If participant 2 learns participant 1's type, he also knows that participant 1 knows her type.

- Participant 2 decides whether he wants to interact with participant 1.
- If participant 2 decides to interact, participant 1 receives an extra 10 points. Participant 2's points depend on participant 1' type. If participant 1 is of type A, participant 2 receives an extra 10 points. If participant 1 is of type B, participant 2's points are reduced by 5 points.
- If participant 2 does decides NOT to interact, both participants receive no extra points, so each of the participants has the 10 points received at the beginning.
- After all participants have made their decision you will receive information about your earnings. At the same time the type of participant 1 and whether an interaction took place will be shown to participants 1 and 2.

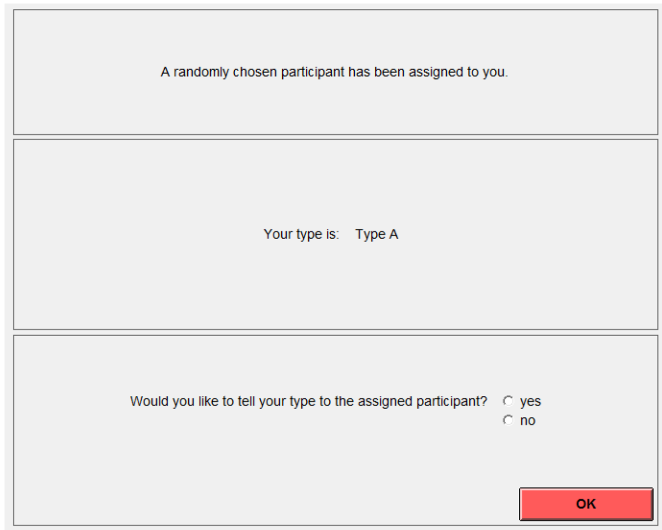
Procedure on-screen

Participant 1 will see the following screen.

Let's assume that participant 1 would like to learn his type. Participant 1 selects "yes", clicks on OK, and learns his type.

[This section was only included in *Imperfect Privacy* and *Perfect Privacy*]

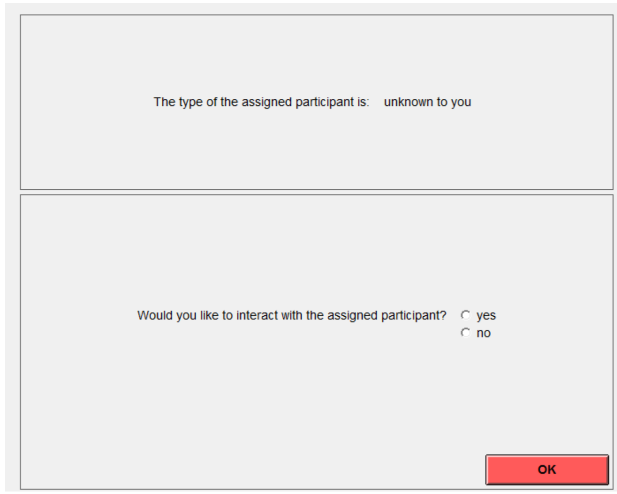
Then participant 1 decides whether she wants to inform participant 2 about his type. Participant 1 will see the following screen (we assume in the example that participant 1 is a type A):



[This section was only included in *Imperfect Privacy*]

If participant 1 knows his type but did not inform participant 2, a random (50% probability) mechanism determines whether participant 2 learns participant 1's type. For the random mechanism, the participant with ID number 12 will roll a die. You will learn the detailed procedure on screen.

Afterwards, participant 2 will see the following screen and decide whether he would like to interact with participant 1. (On the example screen we assume that participant 2 does not know participant 1's type.)



The experiment ends after participant 2 has taken his decision.

At the end of the experiment, all participants 1 learn their type. All participants 2 learn their participant 1's type – no matter whether they have learned the type before. Also, all participants are informed whether an interaction took place and how many points each of the two participants received.

Comprehension questions: (correct answers in parentheses, DD=*Disclosure Duty*, PP=*Perfect Privacy*, IP=*Imperfect Privacy*)

True or false?

□T □F Participant 1 always learns her type at the beginning of the experiment. (F)

□T □F If participant 1 learned her type participant 2 learns it as well. (DD: T, PP &IP: F)

□T □F Participant 2 always learns whether participant 1 knows her type. (F)

□T □F At the end of the experiment all participants 1 learn their type. (T)

□T □F At the end of the experiment all participants 2 learn their participant 1's type. (T)

Further questions:

How many points do you receive before each decision? (10)

What is the probability that participant 1 is of type A? (2/3)

What is the probability that participant 1 is of type B? (1/3)

What is the probability that a participant 1 who didn't want to learn his type is of type A? (2/3)

What is the probability that a participant 1 who didn't want to learn his type is of type B? (1/3)

If participant 1 learned his type [only in PP and IP: "but did not inform participant 2"], what is the probability that participant 2 learns the type nevertheless? (DD: 1, PP: 0 IP: 1/2)

If participant 1 DID NOT learn his type, what is the probability that participant 2 learns the type nevertheless before deciding whether or not to interact? (0)

Please fill in the blanks:

- If participant 2 decided to interact and participant 1 is of type A, participant 2 receives____ (10) points.
- If participant 2 decided to interact and participant 1 is of type B, participant 2 loses ___ (5) points.
- If participant 2 decided to interact, participant 1 receives an extra ____ (10) points.
- If participant 2 refused to interact, participant 1 receives an extra___ (0) points and participant 2 an extra ___ (0) points.

Repeated experiment (translated from German)

[These instructions were distributed after the end of Part 1.]

The Experiment - Summary

- Experiment 2 consists of 10 periods.
- Every period has the same procedure and rules as Experiment 1.
- You have the same role (participant 1 or participant 2) as in Experiment 1 in all 10 periods.
- Participant 1 decides whether she wants to learn her type (A or B).
- [This bullet point was only included in *Perfect Privacy* and *Imperfect Privacy*] If participant 1 decided to learn her type, she decides whether to inform participant 2 about her type.
- Participant 2 decides whether to interact with participant 1.

Important:

- In every period you will be matched with another participant, i.e. with a participant you have not been matched with before (neither in Part 1 or Part 2).
- In every period for every participant 1 it will be randomly determined whether she is type A or B. The probability to be type A or B are the same as in Part 1.
    - The probability of being a type A is 2/3 (or 66.66%).
    - The probability of being a type B is 1/3 (or 33.33%).
- At the end of Part 2, i.e. after period 10, one period will be randomly determined to be payoff relevant for Part 2. For this, the participant with seat number 12 will roll a ten-sided die.
- Afterwards, the participant with seat number 12 will roll a six-sided die to determine whether participants will receive their earnings from part 1 or Part 2.

[After reading the instructions for Part 2, participants had to fill in the following on-screen control questions.]

Control Questions - Experiment 2

Please answer the following questions.

Experiment 2 consists of 10 Periods.	○ true	○ false
At the end of Experiment 2 one of the ten periods will be randomly selected to determine the points achieved in Experiment 2.	○ true	○ false
In every period the probability for Participant 1 to be of Type A is 2/3 (i.e. 66,66%) and to be of Type B 1/3 (i.e. 33,33%).	○ true	○ false
In every period, the type (A or B) of Participant 1 will be determined randomly (using the probabilities above).	○ true	○ false
In each period you form a group of two with the same participant.	○ true	○ false
If Participant 1 has not learned her type, Participant 2 nevertheless learns Participant 1's type before deciding about the interaction.	○ true	○ false
At the end of each period, Participant 1 and Participant 2 (of the same group) learn the type of Participant 1.	○ true	○ false

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