An Exploratory Study of Risk Perception for Data Disclosure to a Network of Firms

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Abstract. Research on the Privacy Calculus, which explains individuals' intention to disclose personal data, mostly focuses on dyadic disclosures in which individuals disclose data to a single firm. So far, little attention has been paid to understand the characteristics of data disclosures to a network of firms. We refer to data sharing of firms in a network as "Business Network Data Exchange" (BNDE). We explore risk perception for data disclosures in a BNDE context based on an exploratory survey. Our results indicate that risk perception for data disclosures in the BNDE context deviates from rational risk perception theory. In particular, individuals perceive the risk to disclose data to a network of two firms as lower than the maximum risk of the separate dyadic data disclosures. These results portend the need for an adapted and nuanced view on perceived risks in this context and have important practical implications for data-sharing among firms.

Keywords: Privacy Calculus, Risk Perception, Business Network Data Exchange

1 Introduction

Most research in the privacy context focuses on situations in which individuals disclose data only to a single firm (e.g., [1]). However, recently more and more firms started to depart from this dyadic consumer-firm relationship and began to share consumer data within a network of firms [2, 3]. In accordance with Bidler et al., we will refer to such procedures as Business Network Data Exchange (BNDE) [4]. An example for BNDE is the music streaming service Spotify: Consumers' data is shared among a network of artists, record labels, and further third parties [5]. Potential differences between dyadic data disclosures and data disclosures in the BNDE context have rarely been examined in the literature. One difference could be the complexity or non-transparency of BNDE situations, which could promote irrational behavior [4, 6–8]. However, the Privacy Calculus, as the dominant theory to explain individuals' intention to disclose personal data by weighing their benefits against their risks, assumes rational behavior [3, 9–11]. As perceived privacy risks are the main factor reducing individuals' intention to disclose in the Privacy Calculus [11–13], we will focus on perceived risks as a key factor in this first approach. We argue that in BNDE data disclosures individuals' risk perception

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differ from dyadic data disclosures. As a starting point for future research in the BNDE context, we first focus on the question: *Is individuals' risk perception of a data disclosure to a BNDE firm network consisting of two firms higher or lower than the dyadic data disclosure to a single firm?*

2 Theoretical Background on Risks

Privacy risk comprises "the degree to which an individual believes that a high potential for loss is associated with the release of personal information to a firm" [3]. In traditional risk perception theory a rational evaluation is expected as the perceived risk of an outcome is defined as the probability of a certain unfavorable outcome multiplied by the severity of the respective outcome [14–16]. If a risk is constituted by different risk components they are often assumed to be additive [17]. The assumption of rational evaluation as well as the additivity of risks was challenged by the Prospect Theory [18, 19]. According to the Prospect Theory individuals transform benefits and risks into a simpler mental representation and use a function to assign a subjective value (perceived benefits and perceived risk) to them. For this value function, monotony as well as a diminishing marginal value is assumed [18, 19]. Since the main emphasis of our paper is on risks, this means particularly that each added potential loss should increase the perceived risk (monotony), but this effect diminishes the more potential losses already exist (diminishing marginal value). In this short paper we focus on the simplest possible BNDE network consisting of just two firms (see Table 1). According to traditional risk theory as well as Prospect Theory, we expect the risk of a data disclosure to a BNDE network with two firms should be perceived higher than the risk of each of the dyadic data disclosures due to the monotony assumption. The risk increase should be caused by the additional (second) firm which obtains the individuals' data. This leads to our proposition 1a.

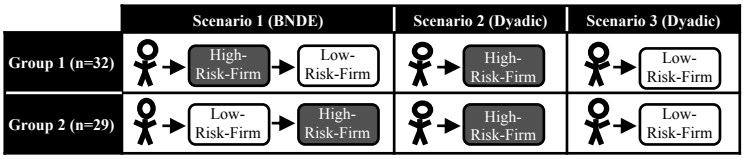
On the other hand, mutual control in cooperations plays a major role for firms [20, 21], thus it is possible that individuals' perceived or assumed control distribution among the firms in the network could alter individuals' risk perception as well. Furthermore, cooperations among firms offer several benefits for consumers and firms. For instance, firms can complement each other [22, 23], e.g., with technical security know-how. Additionally, firms can improve their own internal processes due to knowledge transfer in a cooperation [22, 24–26], which could reduce individuals' perceived risk for BNDE data disclosures, e.g., through better standards of conduct. Both was also described by some participants in pre-test interviews. This leads to our proposition 1b.

Proposition 1a / 1b: *The perceived risk for the BNDE data disclosure is perceived higher (Proposition 1a) / lower (Proposition 1b) than the maximum perceived risk of the two respective dyadic data disclosures.*

3 Exploratory Survey

The survey data (61 subjects, 33 male) was collected from end of November 2017 until mid of December 2017 in cooperation with a panel provider. The subjects were over 18 years, live in Germany, and the age distribution of them reflects the age distribution of German Internet users. The within-subject designed survey contained two groups with three scenarios each and a fixed scenario order (see Table 1).

Table 1. Empirical Setup



The first scenario was a BNDE data disclosure scenario with two existent firms: The subjects saw a screenshot of the respective firm's website and were asked to disclose some personal data (name, address, net-household income, expenses per week, supermarkets they regularly visit, number of persons in the household, phone number). In group 1 (n=32) the subjects disclosed their data to the High-Risk-Firm, which shares the exact same data subsequently not anonymized with the Low-Risk-Firm[1]. This data sharing procedure between the two firms was described in the scenario. In group 2 (n=29) the data was disclosed to the Low-Risk-Firm and then shared with the High-Risk-Firm. In both groups, both firms obtain the same data. The benefit in all three scenarios was identical (20 Euro coupon which could be redeemed in both firms). Two groups were used to control for firm order effects.

After reading the respective scenarios the subjects had to assess their perceived privacy risk (PR) on a seven-point Likert Scale with one being "strongly disagree" and 7 being "strongly agree" based on a scale of Dinev et al. [27] (PR1: It is very risky in this situation to disclose personal information. PR2: There would be high potential for privacy loss associated with data disclosure in this situation. PR3: Personal information could be inappropriately used in this situation. PR4: Providing personal information in this situation would involve many unexpected problems; The average of the items was used as perceived risk). For the High-Risk-Firm a well-known search engine firm and for the Low-Risk-Firm a well-known grocery store were selected. Existing firms were used to make the whole scenario easier to imagine and comprehend. After assessing the risk for the BNDE disclosure (scenario 1) the subjects had to imagine and assess their privacy risk for the two respective dyadic data disclosures without any data sharing to further firms (i.e., scenario 2: disclosure only to the High-Risk-Firm and scenario 3: disclosure only to the Low-Risk-Firm). These two dyadic scenarios were the same in both groups.

4 Results, Discussion, and Outlook

As expected, the risk for the dyadic scenario 2 ($PR_{High\text{-}Risk\text{-}Firm}$) is perceived in both groups significantly higher than the risk for the dyadic scenario 3 ($PR_{Low\text{-}Risk\text{-}Firm}$), thus $PR_{High\text{-}Risk\text{-}Firm}$ is the maximum perceived risk of the two dyadic data disclosures. We used "R" with "EnvStats" for a one-sided paired randomization test for location [28–32] with 100k iterations to test each group separately as well as both groups together (see Table 2, Δ means test statistic). $PR_{BNDE\text{-}DD}$, the perceived risk for scenario 1, was significantly smaller ($\Delta = 40$, $p = 0.001$) than the maximum perceived risk out of the dyadic data disclosures ($PR_{High\text{-}Risk\text{-}Firm}$), thus we reject proposition 1a and accept 1b.

1 We conducted interviews as a pre-test (14 subjects, 11 male, age between 21 and 71) to ensure that the risk level is perceived as different between the two dyadic data disclosures.

Table 2. Preliminary Results

Group \ Scenario	Mean Perceived Risk (Standard Deviation)			One-Sided Paired Randomization Test for	
	PR_{BNDE} Scenario 1	$PR_{High\text{-}Risk\text{-}Firm}$ Scenario 2	$PR_{Low\text{-}Risk\text{-}Firm}$ Scenario 3	$PR_{Low\text{-}Risk\text{-}Firm} < PR_{High\text{-}Risk\text{-}Firm}$	$PR_{BNDE} < PR_{High\text{-}Risk\text{-}Firm}$
Group 1 (n=32)	4.25 (1.52)	5.11 (1.33)	3.52 (1.44)	$\Delta = 50.75$, $p = 0.000$	$\Delta = 27.50$, $p = 0.003$
Group 2 (n=29)	4.90 (1.52)	5.33 (1.33)	4.35 (1.44)	$\Delta = 28.25$, $p = 0.003$	$\Delta = 12.50$, $p = 0.074$
Both groups (n=61)	4.56 (1.61)	5.21 (1.52)	3.92 (1.63)	$\Delta = 79.00$, $p = 0.000$	$\Delta = 40.00$, $p = 0.001$

Contrary to the monotony assumption of the Prospect Theory, the perceived risk for data disclosures in a BNDE context with two firms is perceived as less risky than the maximum of the two respective dyadic data disclosures. These preliminary results indicate that we observe non-monotony behavior that could be explained by positive cooperation effects which reduce individuals' perceived risk due to individuals' assumption of positive changes in firms' data handling process. Future research could review the monotony assumption of the Prospect Theory in the BNDE context and extend the Privacy Calculus by considering positive cooperation effects. Future research should also investigate whether the changes in individuals' risk perception are an instance of irrational behavior in the context of the Privacy Calculus as suggested by Dinev et al. [9].

Additionally, our preliminary results have important practical implications: When the risk for a BNDE data disclosure is perceived as less risky than one of the separate dyadic disclosures, joint data collections are more effective in total and specifically for firms associated with high risk. Since the perceived risk for BNDE data disclosures is nevertheless expected to be the same or higher than the minimum of the separate dyadic data disclosures, it might be beneficial to investigate redistribution mechanisms among firms to balance their cooperation benefits.

The presented preliminary results should be viewed in the light of their limitations: The sample size is small and the within-design without scenario order randomization could distort the results. Also, our results could hold only for BNDE networks consisting of just two firms. To rule out these possible error sources a new survey with bigger sample size, hypothetical firms, varying network size, and a between-subject design is in work.

In sum, we showed that data disclosures in a BNDE context are an interesting and unexplored field that requires further research. Thus, we aim for a deeper understanding in which BNDE constellations (e.g., firm combinations, network characteristics, etc.,) individuals assume positive changes in the data handling process of the network firms and perceive less risk for the BNDE data disclosure. For this, our exploratory study with the focus on risk perception shall serve as a starting point.

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