What is Your Selfie Worth? A Field Study on Individuals' Valuation of Personal Data

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Abstract. Referred to as the new oil, undoubtedly personal data is a valuable resource for organizations. Contrary, it is still blurred, to what extent individuals value their data even though, in a digitized world, users are requested to exchange their data for adequate services. Former research on individuals' valuation of personal data result in scattered, partly contradictious values, depending on the data type, context, and the measurement method. In this study, we aimed to facilitate the valuation for individuals by applying a new and promising measurement methodology: the participants of our field experiment had the chance to sell their selfies in a name-your-own-price auction with repeated bidding and feedback loops. As a result, 39% of our participants were willing to donate or sell their selfies with a median of 5€. Additionally, bidding clusters were identified. Implications for research on the valuation of personal data in terms of privacy are discussed.

Keywords: Value of Personal Data, Privacy, Willingness-to-Sell, Willingness-to-Accept, Name-Your-Own-Price Auction

1 Introduction

There is no question that we live in a period of time where personal information as a resource is becoming increasingly important. Discussions about personal data as the new oil, gold, or fuel are ubiquitous [1, 2] and the successes of data-driven companies like Google outcompetes traditional business models [3]. Notably, five of the top six companies according to their market value in the world are data-driven companies [4, 5]. Thus, personal information is a valuable asset for organizations and they already compete for profiting from it [6].

In contrast, taking the perspective of individuals, the benefits they get from releasing personal data is blurred as they typically do not receive a monetary compensation. Obviously, users benefit from using online services based on personal data, but still privacy concerns about the disclosure of personal information have increased, inherited with the feeling of being unfairly treated [7-9]. Indeed, a study in the Netherlands shows that individuals perceive that they are not getting enough value for their data, as 89% state that the industry benefits the most from data economy [10]. Thus, individuals seem to become more aware of the fact that their data is valuable, at least at an abstract level.

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However, to assess the current data handling processes and regulation approaches, individuals need to know the value of their data more precisely in order to be able to compare the costs of potential privacy losses in terms of data disclosure with the benefits of data usage [11]. In an attempt to investigate individuals' valuation of personal data, recent research measured either users' willingness-to-pay (WTP) for an enhanced privacy level or their willingness-to-sell (WTS) personal information [e.g., 12, 13, 14]. Yet, resulting valuations are scattered between studies depending on the type of data, the context in which the studies are conducted, and the research methodology [15]. So, it seems that individuals' valuation of personal data is not trivial.

Although personal data is reminiscent of traditional valuable resources, it is unlike these previous resources because of its infinity and the fact that it does not consume itself [16]. Further, personal data cannot be compared with ordinary goods for which individuals can set up a price more easily, as data can be sensitive and may make the disclosing person identifiable [17]. This makes it even more complicated for individuals to put a price tag on it. Therefore, research in the field of valuation of personal data requires carefully selected study designs and in turn measurement methods that can handle individuals' potentially vague awareness of the valuation of personal data due to its specificity and minor experience of its monetarization. In this vein, we have conducted a study to measure individuals' valuation of personal data with a new and promising methodology, which is already applied in other contexts for the pricing of 'opaque' goods [18]: a name-your-own-price (NYOP) auction. This methodology can identify the bidders' unique, lowest price for personal data separately for every individual, as it does not require synchronous bids [18-20]. Further, NYOP auctions can be implemented with a repeated bidding option that give individuals the chance to receive feedback if the bids are too high in order to state re-considered bids. This can facilitate individuals' establishment of the price, using the feedback as a source of information and as a trigger to reveal the lowest price [21, 22].

By strengthening the external validity of measuring individuals' value of personal information with a new methodology, we are aiming to answer the following research question: *What monetary value do users assign to their personal information, when being able to state several values after receiving feedback in a name-your-own-price auction with repeated bidding?*

In order to investigate this, we conducted a field experiment where participants could sell personal information in form of selfies in a name-your-own-price (NYOP) auction. We included a repeated bidding option, to make participants feel more comfortable with the situation as they could bid again after receiving feedback about the valuation and thus, can use the haggling process to overcome a lack of information due to low experience with monetized personal data [22]. Indeed, the results indicate that participants used their chances to bid several times, leading to a median final selling price of 5€. Analysis of the provided bids further show different clusters of bidders, indicating that the valuation of personal data is still very individual.

The paper is structured as follows: First, we summarize the theoretical background regarding the valuation of personal information in terms of privacy. In the subsequent chapter, the field study is presented with its methodology and results, before we close the paper with the implications, limitations, and future research directions.

2 Valuation of Personal Information

With the rise of data-driven business models, research and practice are concerned about the valuation of personal data from an individual perspective. Specifically, they are interested in individuals' valuation of privacy in order to understand their data disclosure decisions. In these attempts, scholars were either investigating individuals' willingness-to-sell (WTS) data [e.g., 23, 24] or their willingness-to-pay (WTP) for protecting their personal data [e.g., 12, 25] in order to measure the monetary value of data. However, former research studies are scattered and discordant [15]. Table 1 gives an overview of former studies investigating individuals' valuation of personal data along with their results, type of data under investigation as well as the applied measurement method.

Table 1. Overview of prior valuation of personal data studies
(foreign currencies are translated into € based on the exchange rate in November 2018)

Reference	WTS/ WTP	Type of Data	Research Method	Results (median or mean)
Danezis et al. (2005)	WTS	Location data	Vickrey Auction	11.42€ for research & 22.85€ for commercial purposes (median)
Cvrcek et al. (2006)	WTS	Location data	Vickrey Auction	43€ (median) for research & two-fold for commercial purpose
Brush et al. (2009)	WTS	Location data	Vickrey Auction	88.71€ for academic and commercial purposes (median)
Barak et al. (2012)	WTS	Location data	Close-ended questions	8€ (median)
Benndorf & Normann (2014)	WTS	Contact details & preferences on social networking sites (SNS)	Becker-DeGroot-Marschak method (BDM) & close-ended questions	**BDM** (mean): 8.32€ for preferences 14.88€ for contact details **Close-ended questions:** 24/24 accepted 5€ for preferences 35/42 accepted 5€ for contact details
Huberman et al. (2005)	WTS	Weight & age	Vickrey Auction	Age: 51.22€ (mean) Weight: 65.90€ (mean)
Grossklags & Acquisti (2007)	WTS & WTP	Weight	Surveys: close-ended & open-ended questions	**Open-ended Questions:** 12/12 accepted 0.22€ WTS-offers 12/14 accepted 0.89€ WTS-offers 1/7 accepted 0.22€ WTP-offers 1/14 accepted 0.89€ WTP-offers **Close-ended questions:** Min. WTS: 28.30€ (mean) Max. WTP: 0.71€ (mean)
Bauer et al. (2012)	WTP	SNS	BDM	0€ (mean)

Table 1. (continued) Overview of prior valuation of personal data studies

Reference	WTS/ WTP	Type of Data	Research Method	Results (median or mean)
Spiekermann & Korunovska (2017)	WTP & WTS	SNS	Contingent valuation method (CVM)	**WTP:** No market awareness: 0€ (median) Market awareness: 5€ (median) **WTS:** 49% WTS=0€ 23% 0€ < WTS < 4006€ 28% WTS > 4006€
Krasnova et al. (2009)	WTP	SNS	Conjoint Analysis	Between 14.14€ and 17.24€ a year
Schreiner & Hess (2015)	WTP	SNS	BDM	0.63€ (mean)

As shown in Table 1, the valuations for location data for instance vary between 11€ to 88€ even for the same measurement method of a reverse Vickrey auction due to different samples and variations in the study design [13, 26, 27]. By applying a survey with close-ended questions, Barak et al. identified a valuation of only 8€ [24] enlarging the range of results for location data even further. Supplementary, Benndorf & Normann found evidence that the measurement method can have a remarkable impact on the valuation, as the results for selling SNS details vary up to 10€ between Becker–DeGroot–Marschak mechanism (BDM) and close-ended questions for the same sample [28]. Similarly, Grossklags and Acquisti, ascertain that individuals requested a minimum price of 28€ for selling their weight information when being asked openly, while in the same study, individuals also accepted offers for even 0.22€ [14]. To spread the results even more, weight information was sold for a minimum WTS of 65€ in an auction study by Huberman et al. [23].

Grossklags and Acquisti also investigated individuals' willingness-to-pay for protecting their weight information and found a valuation of 0.71€ conforming a general gap between WTS and WTP [14]. The tendency that individuals demand more money for an object compared to the amount of money they are willing to pay for it, is widely known in research [29] and seems to hold for personal data as well [14]. Indeed, most WTP-studies report rather low values, however, also with variations within the prices. While Bauer et al. and Spiekermann & Korunovska for example found that individuals are not willing to pay a single Euro for their SNS details, the median increased to 5€ when data will be traded [6, 30]. Other studies, like the conjoint analysis by Krasnova et al. show that a user would be ready to pay 14€-17€ per year if no demographic information is used for personalized advertising, while Schreiner & Hess' BDM-participants reported to be willing to pay only 0.63€ for privacy control features within a Facebook premium version [12, 25].

To sum up, investigations on the valuation of personal information from an individual perspective is context-specific and depending on a variety of factors like the measurement method. The high discrepancies of individuals' valuation limit its

implications for decision makers and theory. However, it also demonstrates that individuals have difficulties in assessing a stable and confident monetary value associated with personal information. This was also clearly confirmed by Brush et al. who reported that several of their participants found it challenging to value data and some even tried to ask for hints about what other participants had bid [27]. In our study we address the difficulties in assessing a value of personal information by relying on a novel measurement method. We chose a NYOP auction, because it facilitates individuals' valuation as they receive feedback. Further, it is not subject to a hypothetical bias as individuals were incentivized. In order to be transparent and unambiguous, we clearly explained how the data will be used and by which party.

3 Experimental Study

3.1 Methodology of the Experimental Study

In order to investigate individuals' valuation of personal data in an auspicious new way, we conducted a field experiment using a name-your-own-price auction with repeated bidding options where individuals could sell their selfies. In the following we will describe the experimental setting, the NYOP mechanism, and the study realization.

Experimental Setting. Following the call by Dinev et al. for more realistic study scenarios capturing actual behavior, we were aiming to provide an experimental design for our willingness-to-sell study, where participants perceive the disclosure of personal information as a natural and comprehensive task that leads to an actual sale [31]. As our natural environment is the university, it seems appropriate to develop a scenario that fits into this environment. Thus, students were the target group. We developed a fictional campaign, that our chair is looking for the "faces of our university" to advertise our institution among interested pupils and potential new students. Therefore, the alleged aim of this campaign was to collect selfies of students for marketing purposes in order to promote the university in an authentic and sympathetic way with the slogan "from students for students". For the purpose of this campaign, we implemented a website containing a detailed description of the presented purpose as well as the NYOP auction, with which the students could allegedly sell their selfies to us. We decided to focus on selfies as personal information, as selfies always depict the subjects' faces which turns a picture into personal information compared to ordinary photos. Furthermore, selfies are fashionable and omnipresent and thus, assures familiarity of young students and reduces the risk of misunderstanding [32].

Name-Your-Own-Price (NYOP) Auction with Repeated Bidding. This type of auction is based on an interactive pricing process between buyer and seller, in which both parties are actively involved in finding the price [33, 34]. It is referred to as a haggling process where no average or market price is disclosed [18, 35]. Traditionally, NYOP auctions are initiated by the product sellers to investigate buyers' willingness-to-pay without disclosing the lowest price [e.g., 35]. However, likewise studies building on other auctions [e.g., 13, 23, 26], NYOP auctions are also applicable to investigate

individuals' willingness-to-sell. In doing so, the buyer sets a maximum price (also referred to as the treshold) at which he or she is willing to buy the good, but does not provide any information about it [19, 36]. The potential seller can then initate the first offer and if it meets or undershots the threshold, the sale is made in the amount of the value offered by the seller [19, 37]. However, if the bid is above the limit, it is rejected, but the seller has again the chance to repeat his or her bidding [18].

We opted for a NYOP auction for the following reasons: First, it is applicable for 'opaque' goods where the price is non-transparent [18]. Second, NYOP is used to elicit the lowest price of the bidder and thus, reflects individuals' actual willingness-to-sell transferrable to real-life situations [18]. Besides, in contrast to a "one price for all" strategy, it identifies individuals' unique selling price [19]. Fourth, depending on the design adjustments of the auction, the initiator of the auction can allow several bids in chronological order until the threshold is undershot (repeated bidding) [38]. Thus, individuals receive feedback if the bids are too high, which can serve as valuable information within the haggling process [22, 39], and therefore makes the method appropriate for individuals' vague awareness of the valuation of personal information. Indeed, former research has shown, that individuals' loose statement of a price without any reference information is associated with cognitive effort and therefore they prefer an alternative in which they can select a price or receive information about the valuation, for example by given reference price ranges [35]. However, this would go along with an impeding of the accuracy of the valuation [35] and a biasing in the direction of the external provided reference information [40]. In contrast, the feedback provided by a NYOP auction with repeated bidding option gives individuals something to go on in a subtler way without anchoring them too much as no initial value which then needs to be adjusted [41] is given. A fifth reason is that compared to reverse Vickrey auction often applied in studies investigating individuals' valuation of personal data [e.g., 23, 42], NYOP auctions do not only award one bidder [37]. So not only one participant has the chance to sell his or her personal information, but all who bid accordingly. Indeed, with NYOP there is no need to receive the bids at the same time, as asynchronously arriving bids can be accepted or rejected immediately if the threshold is set before [20].

Due to the design decision on repeated bids, we had to fix the threshold at a low value, because a higher value would have entailed the risk of losing information about a low willingness-to-sell. Thus, we decided to set the threshold to 1€.

We further decided to limit the amount of bids to three, as previous studies on the design of NYOP auctions are based on the assumption that sellers include frictional costs in their choice of bids [38]. Frictional costs are referred to mental efforts for navigating through the website, typing in the selected bids, as well as occuring from the waiting time until the bid is accepted or rejected [38, 39]. In order to prevent these frictional costs from taking on too much importance, we limited the number of bids to three. This also has the advantage of better comparability of the results of all participants in our study. Figure 1 summarizes the mechanism of our NYOP auction.

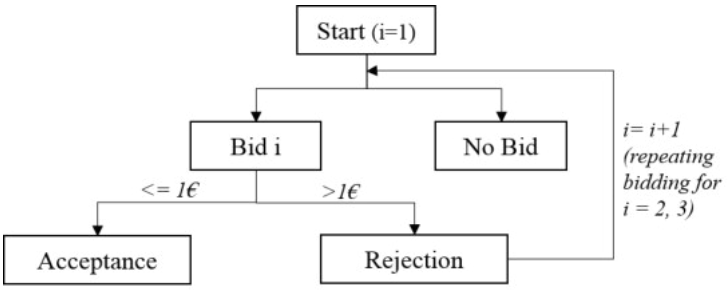

Figure 1. NYOP mechanism of our field experiment, adapted from [38]

Study Realization. We implemented a website for our NYOP auction. When entering the website, the participants were informed about our proposal of buying selfies for the chair's campaign, but we did not provide any price information. In addition to the NYOP mechanism, participants also had the opportunity to donate their selfies for the same presented purpose. This was even possible after making an offer. To meet the challenge that interested sellers might not have an appropriate selfie ready, we provided the chance to bid immediately, but upload the selfie later. However, we clearly stated that the money will only be paid off when the selfie is uploaded. For this purpose, we provided a separate link.

In order to distribute the website to students in our university, the field experiments' website was integrated into a cover online survey. Thus, the participants did not know the real intention of the study. For our cover study, we decided to emphasize on advertisement as a topic as it is omnipresent and therefore interesting for students. To provide students with an additional incentive to participate in the survey, they received 3€ in cash for responding to the online cover survey. The cover study consisted of different parts: After an introductory page providing all GDPR-relevant information, age and gender demographics were collected. Subsequently, different scales investigating participants' perception of advertising were presented. After finishing the cover study, we informed the participants about our current campaign where we are looking for the 'faces of our university' and that they have the chance to gain additional money by participating. By clicking on the next-button, all participants of the former cover study were forwarded to our NYOP website where a detailed description of the auction was given and interested participants could directly type in their bids or donate their selfies as presented above. The participants who were not interested in bidding or donating a selfie at all, were able to return to the initial cover survey by clicking on a "no interest"-button where we informed about the real purpose of the fictive campaign.

We advertised the cover study by distributing flyers on the campus and by setting up a post on our chairs' Facebook profile. From the 186 responses, we had to remove 15 due to bad data quality (incomplete or invalid data), leading to 171 complete data sets. The final sample consisted of 44 females (26%), 125 males (73%), and two unspecified genders (1%). The male quota is representing the gender distribution of our technology-focused university. With a share of 75%, the majority of the participants were between 18 and 25 years as expected due to our targeting on students. Further, 22% of the participants were between 26 and 35, 2% were between 36 and 45, and 1% was older

than 46 years. From the 171 participants, 67 individuals bid or donated, while the other 104 directly returned to the cover survey.

To analyze the data and present the distribution of the bids, we followed former studies on valuation of personal data applying reverse Vickrey auctions [11, 13, 43]. Additionally, we conducted a Wilcoxon signed-rank test and cluster analyses.

3.2 Results of the Experimental Study

The results of our field experiment are presented in the following sections, divided into insights about participants' willingness-to-sell selfies for the advertised campaign and their willingness-to-donate selfies.

Willingness-to-Sell Selfies. In total, 54 participants of our study (32%) bid. The bidders were on average 23.76 years old (SD = 3.77) and consisted of 20% women, 78% men, and 2% unspecified genders. While 40 participants made full use of the possibility to bid three times, seven individuals provided only two offers, and other seven stated just one value. Following the assumption that the last bid provided in a NYOP auction bid series represents the participant's actual willingness-to-sell, the final bid is of most interest. We further assume, that those who bid two values, have already reached their lowest, unique willingness-to-sell within the second offered value, thus, this is their last bid. Analogous, those who eventually provided only one value seem to have such a clear valuation in mind that they only want to express their lowest, unique value in one bid. Thus, we have allocated all of these bids under *final bids*. The mean of these final bids is 29.24€, with bids ranging from 997€ to 1 Cent. The median of these final bids is 5€. The big difference between mean and median and the relatively high standard deviation of 135.24 indicates that there are some very high valuations shifting the mean, which will be analyzed later on. In total, the threshold of 1€ was met or undershot 14 times leading to successful "sales" of selfies. Table 2 summarizes the statistics of the final bids together with the first and second bid.

Table 2. Statistics of the starting bids, second bids, and final bids (in €)

	First / Starting bid	**Second bid**	**Third / Final bid**
Mean (SD)	93.28 (221.91)	50.95 (154.93)	29.24 (135.24)
Median	25	10	5
N	40	47	54
[Max; Min]	[999.99; 2]	[998; 1.1]	[997;0.01]

Looking at the first and second bids, it is striking that the participants successively decreased the values of each bid. For analyzing the differences between the three bids, we conducted pairwise Wilcoxon signed-rank tests as our data was not normally distributed. This test is equivalent to a one-sample t-test conducted at signed ranks substituting the differences and is used for comparing the equality of medians of two samples [44, 45]. We compared the first bids with the second and the final bids as well as the second bids with the final bids. Since we were interested in differences between

two bids, we had to exclude seven values from the test which only provided one bid. The participants who provided two bids are analyzed within the comparison of the second and final bids. The test statistics summarized in Table 3 show that all bids are significantly different from each other with a large effect size (r) based on Cohen's indexes [46, 47]. Based on the medians reported in Table 2, the first bids' median is 25€, while the second bid decreases by 40% leading to a median of 10€. The decrease from the second to the final bid is even higher with 50%.

Table 3. Wilcoxon signed-rank test statistics

	z	p-value	N	r
First bid – Second bid	-5.514	.000	40	.87
Second bid – Final bid	-5.912	.000	47	.86
First bid – Final bid	-5.513	.000	40	.87

We further investigated the distribution of the bid series in more detail. As some of the bid series were appreciably higher than others, we conducted hierarchical cluster analyses (with median clustering, single linkage, and ward methods) for testing whether there are different bidder groups [48, 49]. For these analyses we imputed the missing values in the bid series where only one or two values were named by filling the absent bids with their only stated (or in the case where only one bid is missing with the second stated) bid. This is again in line with our assumption that the participants specified their valuation within their *final bid* which was for seven participants the only stated value.

Surprisingly, the analyses revealed no clear clustering as the very high values were so scattered that it would lead to clusters with very few values. In a second step, we excluded the nine very high values from further analyses that were identified by the single linkage cluster analysis in addition to a z-based outlier-analysis. However, these bidders should not be seen as outliers in a traditional sense, as these are no measurement errors, but show the respondents' extraordinary high value proposition of personal data in terms of privacy. These might be therefore seen as a group of *privacy protectors*.

A re-iteration of the cluster analyses could identify three different clusters. Figure 2 depicts the scatterplot of these bid series as well as the allocation of them to the clusters.

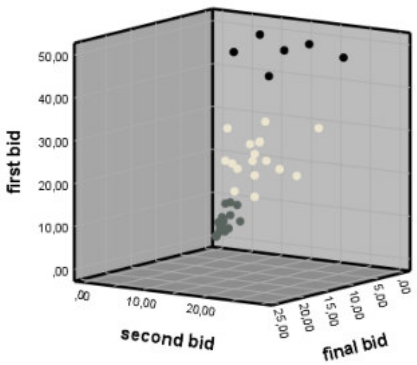

Figure 2. Scatterplot of adjusted bid series and their clusters

The first cluster, colored in black (Figure 2) is characterized by the fact that all bidders start with 50€ as first bids. The second bid is around 20€ and the final one about 10€ as depicted in Table 4. We call this cluster *striding out bidders* as the steps between the bids are with absolute decreases of 30€ and 10€ wider compared to those from the subsequent clusters. While the bidders in the white cluster show a similar final bid as the black cluster, their starting bid was only 25€ in median. Hence, their absolute steps between the bids were smaller compared with the former cluster. Thus, we name them *moderate bidders*. Finally, the bidders allocated to the grey cluster bid relatively low in all three bids. The median of the final bid in this *low bidders'* cluster meets our threshold of 1€.

Table 4. Statistics of the hierarchical cluster analysis (ward method) in €

Cluster (n)		First bid	Second bid	Final bid
Black (n=6)	**Mean**	50	20.83	11.20
Striding out bidders	**Median**	50	20	10
White (n=17)	**Mean**	24.16	15.41	10.01
Moderate bidders	**Median**	25	15	10
Grey (n=22)	**Mean**	4.36	2.91	1.84
Low bidders	**Median**	4.25	2	1

Table 5 summarizes the demographics of the three bidder groups identified by the clusters analyses as well as the *privacy protectors*. However, an ANOVA test could not identify significant statistical differences between the groups with regard to age or gender of the participants.

Table 5. Demographics of the bidder groups

Bidder group	Mean age (in years)	Women	Men	Others
Privacy protectors	25.44 (SD = 4.79)	11.11%	77.78%	11.11%
Striding out bidders	21.17 (SD = 1.34)	16.67%	83.33%	0%
Moderate bidders	23.71 (SD = 3.59)	17.65%	82.35%	0%
Low bidders	23.82 (SD = 3.46)	27.27%	72.73%	0%

Willingness-to-Donate Selfies. Additionally, participants had the chance to donate their selfies for the stated purpose. In total, 13 participants chose this option. From these, 38% were female, 62% male. The average age was 24.69 years (SD = 3.07). Three of these donators started to bid values in advance: One person bid 15€ before deciding to donate, another individual tried a 3€-bid first, and the third person bid 3€ and even 1€ so that the offer would be accepted if not donated. All results are discussed and implications are provided in the following.

4 Discussion

Within this study, we investigated individuals' valuation of personal data by conducting a NYOP auction with repeated bidding and feedback loops. In the following the implications as well as limitations and future research suggestions are discussed and a conclusion is given.

4.1 Implications of the Study

Our study adds to research in several ways. First, our main *theoretical contribution* is the investigation of the value individuals assign to their personal information in a realistic, highly accessible, and comprehensive fashion. In this vein, we relied on a new and promising method, a NYOP auction with repeated bidding revealing individuals' lowest, unique selling price [18, 19]. Due to the opportunity to bid several times after receiving feedback, individuals feel more comfortable by stating their valuation as they can use the haggling process as a source of information [22] and re-think their valuation with each bid. However, bidders are not anchored as no initial price as a starting point is presented [41]. In contrast to other auctions, sellers in NYOP auctions with a repeated bidding option can strategically start with a higher, internal generated value and then sequentially approach their own lowest bid based on feedback [39], revealing individuals' actual WTS.

Further analyses reveal subsequent implications. Thereby, it is striking that except for seven participants stating one value, most of the bidders took the chance to bid twice or three times. The three bids were significantly different from each other, decreasing by 40% from the first to the second and 50% from the second to the final bid. Looking deeper into the distribution of the bid series itself, we can observe some scattered, high bid series, referred to as the group of *privacy protectors* and three clusters of bidders with similar valuations. We could see very low bids of 1€ in median within the *low bidders'* cluster. These make up 41% of the bid series. Another two groups of bid series, the *moderate bidders* (31% of the bidders) and the *striding out bidders* (11%), end up both at a final bid of about 10€ in median, but differentiate by their bidding strategies: While the bid series in the first cluster start with a higher bid of 50€, the bid series in the second cluster are more temperate, starting with 25€ in median.

Lastly, the results show that 39% of the participants were willing to sell or donate a selfie. The 13 donations indicate that these participants seem to believe in the good cause of our campaign and a monetary compensation is not required. We further hypothesize that the three individuals that first bid and then decided to donate, perceived the threshold as "not worth" and then rather wanted to support the campaign by a donation.

Beyond that, we show that our study participants would sell their selfie for 5€ in median. This monetary value seems convincing as current photo-selling platforms offer about 5€ to their users for one picture. For example, *Candidly Images* and *Foap* provide marketplaces where normal hobby photographers can sell their photos to interested parties [50, 51]. The photos are sold for around 10$ whereby the seller receives 5$

(about 4.39 € based on exchange rate in August 2018) as a reward. Thus, it is indeed a price where demand and offer come about.

To conclude, we found participants' willingness-to-sell personal data in this field study to be realistic, but due to the scattered high values and the three different clusters, still to be very individual as well. This implies that valuation of personal information in terms of privacy is very sensitive, context-specific, and individual. As a result, it is not generalizable across humans.

Beyond theoretical implications, our research also provides *practical contributions.* Not only since the German Chancellor Angela Merkel proposed to tax the sale of personal data, the investigation of individuals' valuation of personal data is becoming an important issue [52]. Already in 2014 Jentzsch indicated that a truthful valuation of personal data is an important matter in this time, as an increasing number of online platforms allow the sale of personal data to companies [42]. Indeed, more and more platforms appear (e.g., Datacoup, Data Fairplay, Datum) on which users can actively sell their personal data they are willing to disclose to interested companies and are therefore monetary compensated [53]. In this vein, our research contributes to practice by providing a mechanism that fosters the measurement of individuals' unique, lowest valuation of personal data which can also help providers of data-selling platforms to evaluate their prices and assess their business chances.

Secondly, when individuals use social networking sites (SNS) like Facebook or Instagram, they are agreeing to the term that the provider receives the license to use all shared images [54, 55]. Thus, individuals are using an apparent free service but they are paying with their personal information in terms of their photos and user behavior in general. In this vein, one could argue that SNS users do not value their photos as they give it up for free. However, our results provide evidence that Internet users indeed value their photos beyond free services in return.

4.2 Conclusion, Limitations, and Future Research Suggestions

Personal information has its value for organizations and users, at least at an abstract level. Whereby organizations trade personal information like an asset, individuals take a rather passive role in this process. In order to be able to assess current data handling approaches, individuals are requested to assign a value to their personal data. However, former research investigating users' valuation of personal data is scattered. Against this background, we conducted an experimental study with a NYOP auction allowing repeated bids and therefore feedback loops aiming to facilitate the valuation. In total, 39% of our participants were willing to sell or donate their selfies to the university for advertising purposes with a median price of 5€. The applied method can reveal individuals' actual, lowest, and unique valuation and can therefore help Internet users to pave the way from a 'passive spectator' to an 'active beneficiary'.

However, our study comes not without limitations. First, the sample of our experimental study consisted of more male than female participants due to the gender distribution of our technology-focused university. Although we saw in the data a tendency that women were more willing-to-donate, this tendency was not significant. Further, we relied on a German sample which could limit the generalizability of our

study results for other cultures. Thus, we call for a deeper investigation of gender differences with a more balanced, international sample.

Further, as shown by the literature review, studies on the valuation of personal information are very context sensitive, meaning that the willingness-to-sell personal information and the actual requested value depends strongly on the circumstances under which the study was conducted [15]. Thus, we were aiming to optimize these circumstances by stating in an easy understandable manner who is buying, what data, for which purpose. Further, in our scenario, there were no complex partner structures involved, as the university was the only buying party which seems applicable as several willingness-to-sell studies were already successfully providing an experimental setup in the university environment [e.g., 13, 24, 26]. However, it might be interesting to conduct a NYOP auction with a repeated bidding option in another context in order to improve the transferability of our results.

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References

1. Medium, https://medium.com/datareum/data-is-the-new-gold-e6eb1aeeb640 (Accessed: 11.08.2018)
2. Economist, https://www.economist.com/leaders/2017/05/06/the-worlds-most-valuable-resource-is-no-longer-oil-but-data (Accessed: 11.08.2018)
3. Brynjolfsson, E., Hitt, L.M., Kim, H.H.: Strength in Numbers: How Does Data-Driven Decisionmaking Affect Firm Performance? SSRN (2011)
4. Statista, https://www.statista.com/statistics/263264/top-companies-in-the-world-by-market-value/ (Accessed: 25.07.2018)
5. Slotin, J., http://www.data4sdgs.org/news/what-do-we-know-about-value-data (Accessed: 25.07.2018)
6. Bauer, C., Korunovska, J., Spiekermann, S.: On the Value of Information - What Facebook Users Are Willing to Pay. In: European Conference on Information Systems Proceedings (2012)
7. Acquisti, A., Taylor, C., Wagman, L.: The Economics of Privacy. Journal of Economic Literature 54, 442-492 (2016)
8. Culnan, M.J., Armstrong, P.K.: Information Privacy Concerns, Procedural Fairness, and Impersonal Trust: An Empirical Investigation. Organization Science 10, 104-115 (1999)
9. Culnan, M.J., Bies, R.J.: Consumer Privacy: Balancing Economic and Justice Considerations. Journal of Social Issues 59, 323-342 (2003)
10. DDMA, https://ddma.nl/download/53179/ (Accessed: 25.07.2018)
11. Carrascal, J.P., Riederer, C., Erramilli, V., Cherubini, M., de Oliveira, R.: Your Browsing Behavior for a Big Mac: Economics of Personal Information Online. In: Proceedings of the 22nd International Conference on World Wide Web, pp. 189-200. ACM (2013)
12. Krasnova, H., Hildebrand, T., Guenther, O.: Investigating the Value of Privacy on Online Social Networks: Conjoint Analysis. In: International Conference on Information Systems Proceedings. Paper 173 (2009)
13. Danezis, G., Lewis, S., Anderson, R.J.: How Much is Location Privacy Worth? In: WEIS vol. 5, (2005)

14. Grossklags, J., Acquisti, A.: When 25 Cents is Too Much: An Experiment on Willingness-To-Sell and Willingness-To-Protect Personal Information. In: WEIS, (2007)
15. Wagner, A., Wessels, N., Buxmann, P., Krasnova, H.: Putting a Price Tag on Personal Information - A Literature Review. In: Hawaii International Conference on System Sciences (HICSS), vol. 51, Waikoloa Village, Hawaii (2018)
16. Bharosa, N., Luitjens, S., van Wijk, R., Pardo, T.: Panel: Removing the Barriers for Personal Data Management. In: Proceedings of the 19th Annual International Conference on Digital Government Research: Governance in the Data Age, pp. 125. ACM (2018)
17. Spiekermann, S., Böhme, R., Acquisti, A., Hui, K.-L.: Personal Data Markets. Electronic Markets 25, 91-93 (2015)
18. Terwiesch, C., Savin, S., Hann, I.-H.: Online Haggling at a Name-Your-Own-Price Retailer: Theory and Application. Management Science 51, 339-351 (2005)
19. Hinz, O., Hann, I.-H., Spann, M.: Price Discrimination in E-Commerce? An Examination of Dynamic Pricing in Name-Your-Own Price Markets. MIS Quarterly 81-98 (2011)
20. Fay, S.: Partial-Repeat-Bidding in the Name-Your-Own-Price Channel. Marketing Science 23, 407-418 (2004)
21. Klemperer, P.: Auctions: Theory and Practice, Economics Group, Nuffield College, University of Oxford. Economics Papers (2004)
22. Liu, J., Dai, R., Wei, X.D., Li, Y.: Information Revelation and Customer Decision-Making Process of Repeat-Bidding Name-Your-Own-Price Auction. Decision Support Systems 90, 46-55 (2016)
23. Huberman, B.A., Adar, E., Fine, L.R.: Valuating Privacy. IEEE Security & Privacy 3, 22-25 (2005)
24. Barak, O., Cohen, G., Gazit, A., Toch, E.: The Price is Right?: Economic Value of Location Sharing. In: Proceedings of the 2nd ACM Conference on Pervasive and Ubiquitous Computing Adjunct Publication, pp. 891-900. ACM, Zurich, Switzerland (2013)
25. Schreiner, M., Hess, T.: Why Are Consumers Willing to Pay for Privacy? An Application of the Privacy-freemium Model to Media Companies. In: European Conference on Information Systems Proceedings, (2015)
26. Cvrcek, D., Kumpost, M., Matyas, V., Danezis, G.: A Study on the Value of Location Privacy. In: Proceedings of the 5th ACM Workshop on Privacy in Electronic Society, pp. 109-118. ACM (2006)
27. Brush, A., Krumm, J., Scott, J.: Exploring End User Preferences for Location Obfuscation, Location-Based Services, and the Value of Location. Proceedings of the 12th ACM International Conference on Ubiquitous Computing, pp. 95-104, Copenhagen, Denmark (2010)
28. Benndorf, V., Normann, H.T.: The Willingness to Sell Personal Data. DICE Discussion Paper, No. 143., (2014)
29. Horowitz, J.K., McConnell, K.E.: A Review of WTA/WTP Studies. Journal of Environmental Economics and Management 44, 426-447 (2002)
30. Spiekermann, S., Korunovska, J.: Towards a Value Theory for Personal Data. Journal of Information Technology 32, 62-84 (2017)
31. Dinev, T., McConnell, A.R., Smith, H.J.: Research Commentary—Informing Privacy Research Through Information Systems, Psychology, and Behavioral Economics: Thinking Outside the "APCO" Box. Information Systems Research 26, 639-655 (2015)
32. Statista, https://www.statista.com/statistics/683924/us-adults-familiar-selfie-age/ (Accessed: 27.08.2018)
33. Spann, M., Bernhardt, M., Häubl, G., Skiera, B.: It's All in How You Ask: Effects of Price Elicitation Format on Bidding Behavior in Reverse-Pricing Markets. In: Proceedings of the

26th Annual Conference of the Society for Judgment and Decision Making (SJDM) Toronto, Canada, (2005)
34. Hann, I.-H., Hinz, O., Spann, M.: Dynamic Pricing in Name-Your-Own-Price Channels: Bidding Behavior, Seller Profit and Price Acceptance. In: Workshop on Information Systems and Economics (WISE), (2006)
35. Chernev, A.: Reverse Pricing and Online Price Elicitation Strategies in Consumer Choice. Journal of Consumer Psychology 13, 51-62 (2003)
36. Amaldoss, W., Jain, S.: Joint Bidding in the Name-Your-Own-Price Channel: A Strategic Analysis. Management Science 54, 1685-1699 (2008)
37. Spann, M., Tellis, G.J.: Does the Internet Promote Better Consumer Decisions? The Case of Name-Your-Own-Price Auctions. Journal of Marketing 70, 65-78 (2006)
38. Spann, M., Skiera, B., Schäfers, B.: Measuring Individual Frictional Costs and Willingness-to-Pay via Name-Your-Own-Price Mechanisms. Journal of Interactive Marketing 18, 22-36 (2004)
39. Hann, I.-H., Terwiesch, C.: Measuring the Frictional Costs of Online Transactions: The Case of a Name-Your-Own-Price Channel. Management Science 49, 1563-1579 (2003)
40. Johnson, J.W., Cui, A.P.: To Influence or not to Influence: External Reference Price Strategies in Pay-What-You-Want Pricing. Journal of Business Research 66, 275-281 (2013)
41. Tversky, A., Kahneman, D.: Judgment Under Uncertainty: Heuristics and Biases. Science 185, 1124-1131 (1974)
42. Jentzsch, N.: Auctioning Privacy-Sensitive Goods. Annual Privacy Forum, pp. 133-142. Springer (2014)
43. Staiano, J., Oliver, N., Lepri, B., de Oliveira, R., Caraviello, M., Sebe, N.: Money Walks: A Human-Centric Study on the Economics of Personal Mobile Data. In: Proceedings of the 2014 ACM International Joint Conference on Pervasive and Ubiquitous Computing, pp. 583-594. ACM (2014)
44. Zimmerman, D.W., Zumbo, B.D.: Relative Power of the Wilcoxon Test, the Friedman Test, and Repeated-Measures ANOVA on Ranks. The Journal of Experimental Education 62, 75-86 (1993)
45. Imam, A., Mohammed, U., Moses Abanyam, C.: On Consistency and Limitation of Paired T-Test, Sign and Wilcoxon Sign Rank Test. IOSR Journal of Mathematics 10, 1-6 (2014)
46. Rosenthal, R.: Parametric Measures of Effect Size. In: Cooper, H., Hedges, L.V. (eds.) The Handbook of Research Synthesis, vol. 621, pp. 231-244. New York: Russell Sage Foundation. (1994)
47. Cohen, J.: A Power Primer. Psychological Bulletin 112, 155 (1992)
48. Yim, O., Ramdeen, K.T.: Hierarchical Cluster Analysis: Comparison of Three Linkage Measures and Application to Psychological Data. The Quantitative Methods for Psychology 11, 8-21 (2015)
49. Kaufman, L., Rousseeuw, P.J.: Finding Groups in Data: An Introduction to Cluster Analysis. John Wiley & Sons, Hoboken, New Jersey (2009)
50. Foap, https://www.foap.com/terms (Accessed: 16.08.2018)
51. Candidlyimages, https://www.candidlyimages.com/About/FAQ (Accessed: 16.08.2018)
52. DW, https://www.dw.com/en/taxes-coming-to-big-data-in-germany/a-43972540 (Accessed: 24.07.2018)
53. Brustein, J., http://www.nytimes.com/2012/02/13/technology/start-ups-aim-to-help-users-put-a-price-on-their-personal-data.html?_r=1&ref=technology (Accessed: 03.11.2017)
54. Facebook, https://www.facebook.com/terms.php (Accessed: 28.08.2018)
55. Instagram, https://help.instagram.com/581066165581870/ (Accessed: 28.08.2018)