Caring about Sharing: User Perceptions of Multiparty Data Sharing

Expanded Statistical Result Tables

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1 Statistics

This supplementary material details the process and results of our statistical analysis. We will refer to relevant sections of the paper throughout to ensure it is clear which results these statistics were used for. All statistical results presented use a significance level of 0.05. We use non-parametric statistical tests as our data is not normally distributed. This leaves the potential for incorrectly finding a difference insignificant. However, it decreases the risk of incorrectly saying a difference is significant. Additionally, when presenting the results of multiple comparison procedures, we report the p-value adjusted using the Bonferroni correction to account for the increased chance of false positive results due to multiple comparisons.

When presenting a results here, we refer to the corresponding section in the main body of the paper. See Table 1 for the variable names, collaboration types, and their corresponding labels used throughout this section. The multiparty data sharing scenarios and corresponding labels can be seen in Figure 1.

Variable	**Label**
All scenarios (general)	(a)
Concealed consent	(b)
Assumed consent	(c)
Opt-out consent	(d)
Opt-in consent	(e)
Retained indefinitely	(f)
Retained while in use	(g)
Retained for set time	(h)
Generating revenue	(i)
Provide user remuneration	(j)
Improving services	(k)
Collaboration Type	**Label**
Validation	(V)
Two-way Two-Party Exchange	(1)
One-way Two-Party Exchange	(2)
Many-to-One Exchange	(3)
Acquisition	(4)
Merger then Acquisition	(5)

Table 1: Reference table for labels corresponding to usage controls and collaboration types.

1.1 Within Informed Consent, Data Retention, and Purpose

The statistics shown in this section correspond to the results presented in Section 4.1 of the paper. We perform a Friedman's two-way analysis of variance by ranks for each of the distributions of acceptability: within informed consent groups, within data retention groups, and within purpose groups. The results of which can be seen in Table 2.

We perform a post-hoc analysis to identify which variables within a group differ and in what direction, for example within data retention, how do variables (f), (g), and (h) differ. To do this, we use Dunn's multiple comparison procedure which is shown in Table 3. The difference in mean rank (e.g., the mean rank of Var 1 subtract the mean rank of Var 2) shows the direction of the difference in acceptability of the pair. All pairs of variables have significantly different distributions of acceptability except for the (g), (h) variable pair from within data retention.

1.2 Collaboration Types

The statistics in this section correspond to the results presented in Section 4.2 of the paper. As in the main body of the paper, we first present the results comparing acceptability between collaboration types and follow up with the results comparing within types.

Between collaboration types. We perform a Kruskal-Wallis test on the distribution of acceptability of each collaboration type (1-5) for each variable ((a) through (k)) shown

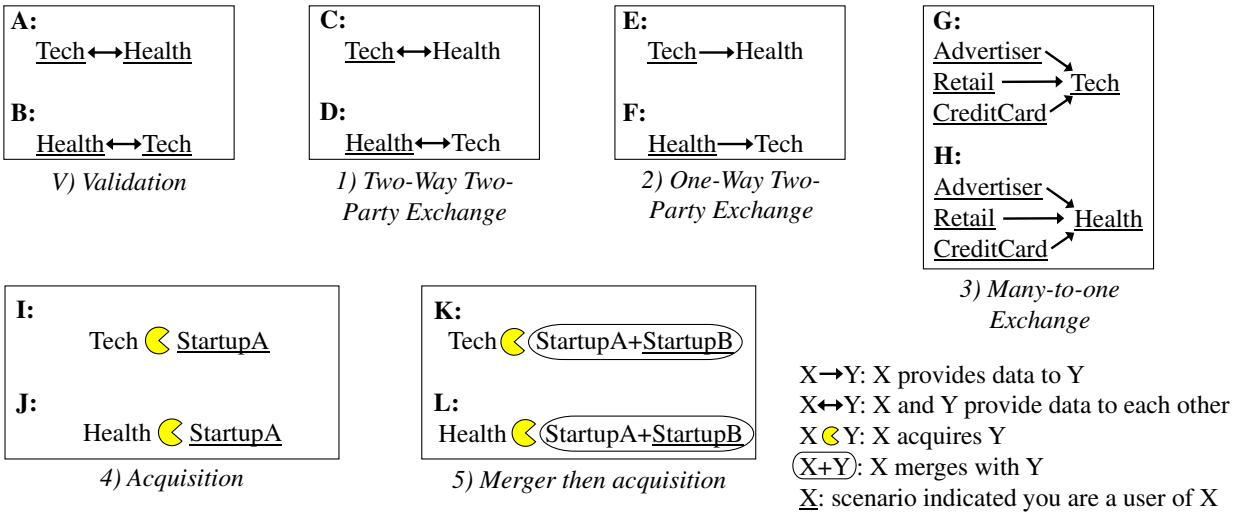

Figure 1: Overview of scenarios (A-L) presented in our survey and collaboration types (V, 1-5) that we investigate. For reference, Scenario C, "TechForYou is a large internet company that offers a search engine, email accounts and smartphone platforms to users. GoodHealth runs a chain of hospitals across the country and stores health data for millions of patients during its day-to-day operations. TechForYou and GoodHealth will share the customer data they hold with one another. You are a customer of TechForYou".

The distributions of acceptability for...	**Test Statistic**	***p***
...consent groups (b), (c), (d), (e) are the same	899.29	**<0.001**
...retention groups (f), (g), (h) are the same	255.08	**<0.001**
...purpose groups (i), (j), (k) are the same	435.79	**<0.001**

Table 2: Friedman's two-way analysis of variance by ranks results for the distribution of acceptability within informed consent groups, data retention groups, and purpose groups. For all variables within groups $N = 916$. A row with bold p value indicates that we reject that hypothesis and that for that group, the acceptability differs significantly between variables within the group.

in Table 4. We perform a post-hoc analysis for variables that have significant differences from the Kruskal-Wallis test to identify which collaboration types have pairwise differences. We use Dunn's multiple comparison procedure and show the results in Table 5. Only the collaboration type pairs that have significantly different distributions of acceptability are reported. The difference in mean rank (e.g., the mean rank of Type X subtract the mean rank of Type Y) shows the direction of the difference in acceptability collaboration types.

Var 1, Var 2	**Difference in Mean Rank**	**Std. Test Statistic**	***p***
	Informed Consent		
(a), (b)	-0.85	-14.098	<0.001
(a), (c)	-1.07	-17.663	<0.001
(a), (d)	-1.44	-23.798	<0.001
(b), (c)	-0.22	-3.565	0.002
(b), (d)	-0.59	-9.700	<0.001
(c), (d)	-0.37	-6.135	<0.001
	Data Retention		
(f), (g)	-0.46	-9.778	<0.001
(f), (h)	-0.51	-10.864	<0.001
(g), (h)	-0.05	-1.086	0.832
	Purpose		
(i), (j)	-0.71	-15.186	<0.001
(i), (k)	-0.55	11.764	<0.001
(k), (j)	-0.16	-3.423	0.002

Table 3: Dunn's multiple comparison test results for the distribution of acceptability compared pairwise between variables within informed consent, data retention, and purpose groups. All p-values are adjusted for multiple comparisons (6 comparisons for the consent group, 3 for each of the data retention and purpose groups) using Bonferroni correction.

Between collaboration types, the acceptability distribution of...	**Test Statistic**	***p***
...(a) is the same	26.724	**<0.001**
...(b) is the same	6.026	0.197
...(c) is the same	15.113	**0.004**
...(d) is the same	10.340	**0.035**
...(e) is the same	12.058	**0.017**
...(f) is the same	7.862	0.097
...(g) is the same	2.774	0.596
...(h) is the same	13.261	**0.010**
...(i) is the same	7.044	0.134
...(j) is the same	6.337	0.175
...(k) is the same	10.337	**0.035**

Table 4: Kruskal-Wallis test results for the distribution of acceptability of variables (a) through (k) between collaboration types {1 ($N = 140$), 2 ($N = 150$), 3 ($N = 134$), 4 ($N = 162$), 5 ($N = 170$)}. A row with bold p value indicates that we reject that hypothesis and that for that variable, the acceptability differs significantly between data sharing types.

Collaboration Type X, Type Y	**Difference in Mean Rank**	**Std. Test Statistic**	***p***
(a) All scenarios (general)			
2, 4	-75.46	-3.124	0.018
2, 5	-69.42	-2.907	0.037
3, 4	-104.31	4.190	<0.001
3, 5	-98.27	3.990	0.001
(c) Assumed consent			
2, 4	-68.28	-2.825	0.047
2, 5	-68.23	-2.855	0.043
(d) Opt-out consent			
No pairwise differences due to Bonferroni correction.			
(e) Opt-in consent			
No pairwise differences due to Bonferroni correction.			
(h) Retained for set time			
2, 4	-71.96	-2.973	0.030
(k) Improving services			
2, 5	-70.38	-2.948	0.032

Table 5: Dunn's multiple comparison test results for the distribution of acceptability compared pairwise between collaboration types. All p values are adjusted for multiple comparisons (10 comparisons per variable) using Bonferroni correction.

Within collaboration types. Each collaboration type (1-5) is comprised of two scenarios (from C to L), so within each collaboration type we perform a Mann-Whitney U test for each variable ((a) through (k)). For 'two-way two-party exchange' (type 1), we fail to identify any significant differences in the distribution of acceptability for its constituent scenarios C ($N = 73$) and D ($N = 67$). In 'one-way two-party exchange' (type 2), we identify significant differences between scenarios E and F in seven variables which can be seen in Table 6. For 'many-to-one exchange' (type 3), we identify one significant difference between scenario G ($N = 64$) and H ($N = 70$) for 'assumed consent' (variable (c), $p = 0.035$, std. test statistic= -2.107, mean rank difference= 13.84). For 'acquisition' (type 4), we identify a significant difference for 'opt-in consent' (variable (e)) between scenarios I ($N = 79$) and J ($N = 83$) ($p = 0.004$, std. test statistic= -2.915, mean rank difference= 20.24). For 'merger then acquisition' (type 5), we fail to identity any significant differences in acceptability of variables for scenario K ($N = 74$) compared with L ($N = 96$).

Within One-Way Two-Party Exchange (E, F), the acceptability distribution of...	**Difference in Mean Rank**	**Std. Test Statistic**	***p***
...(a) is the same	16.04	-2.322	0.020
...(e) is the same	17.47	-2.550	0.011
...(g) is the same	16.11	-2.315	0.021
...(h) is the same	15.19	-2.188	0.029
...(i) is the same	17.22	-2.603	0.009
...(j) is the same	22.22	-3.202	0.001
...(k) is the same	15.24	-2.196	0.028

Table 6: Mann-Whitney U test results for the One-Way Two-Party Exchange (collaboration type 2) scenarios {E ($N = 81$), F ($N = 69$)}.

1.3 Demographics

The statistics in this section correspond to the results in Section 4.3 of the paper. We show the statistical results for demographic variations, first, due to gender and, second, due to age.

Gender acceptability variations. For gender, we performed a Mann-Whitney U Test with two groups comprised of 432 men and 455 women compared for each of the variables (a through k). We found a significant result for 'concealed consent' (variable (b)). We can conclude that men found their consent not being explicitly granted, to be significantly more acceptable than women did ($p = 0.008$, std. test statistic= -2.647). The difference in mean rank between men and women for 'concealed consent' was 40.45.

Age acceptability variations. To examine how age group influences acceptability for each of the variables, (a) through (k), we performed a Kruskal-Wallis test comparing the five

age groups {18-24 ($N = 154$), 25-34 ($N = 201$), 35-44 ($N = 140$), 45-54 ($N = 197$), 55-64 ($N = 201$)}. These results are shown in Table 7.

In order to identify which age groups have pairwise differences, we conduct a post hoc Dunn's test shown in Table 8. Only the age group pairs that have significantly different distributions of acceptability are reported in this table. The difference in mean rank (e.g., the mean rank of Group 1 subtract the mean rank of Group 2) shows the direction of the difference in acceptability of the pair of age groups.

Between age groups, the acceptability distribution of...	**Test Statistic**	***p***
...(a) is the same	14.376	**0.006**
...(b) is the same	27.059	**<0.001**
...(c) is the same	6.382	0.172
...(d) is the same	8.848	0.065
...(e) is the same	4.069	0.397
...(f) is the same	21.429	**<0.001**
...(g) is the same	11.841	**0.019**
...(h) is the same	12.913	**0.012**
...(i) is the same	33.828	**<0.001**
...(j) is the same	11.977	**0.018**
...(k) is the same	25.893	**<0.001**

Table 7: Kruskal-Wallis test results for the distribution of acceptability of variables (a) through (k) between age groups {18-24, 25-34, 35-44, 45-54, 55-64}. A row with bold p value indicates that we reject that hypothesis and that for that variable, the acceptability differs significantly between age groups.

Group 1, Group 2	**Difference in Mean Rank**	**Std. Test Statistic**	***p***
(a) All scenarios (general)			
35-44, 45-54	-90.38	-3.246	0.012
(b) Concealed consent			
55-64, 18-24	-100.72	4.090	<0.001
55-64, 25-34	-94.35	4.113	<0.001
55-64, 45-54	-92.10	3.995	0.001
(f) Retained indefinitely			
55-64, 18-24	-95.98	3.628	0.003
55-64, 25-34	-76.66	3.111	0.019
55-64, 45-54	-87.21	3.521	0.004
(g) Retained while in use			
No pairwise differences due to Bonferroni correction.			
(h) Retained for set time			
35-44, 45-54	-79.41	-2.847	0.044
(i) Generating revenue			
35-44, 45-54	-78.91	-2.900	0.037
55-64, 18-24	-121.07	4.593	<0.001
55-64, 25-34	-84.94	3.459	0.005
55-64, 45-54	-121.64	4.929	<0.001
(j) Provide user remuneration			
55-64, 25-34	-76.83	3.075	0.021
(k) Improving services			
35-44, 18-24	-105.96	3.606	0.003
55-64, 18-24	-114.78	4.260	<0.001
55-64, 25-34	-75.21	2.996	0.027
55-64, 45-54	-77.57	3.075	0.021

Table 8: Dunn's multiple comparison test results for the distribution of acceptability compared pairwise between age groups for variables that have significant differences. All p values are adjusted for multiple comparisons (10 comparisons per variable) using Bonferroni correction.