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Concession crossover in electronic negotiations*

by

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Abstract: Negotiation is a joint decision making process involving making concessions by the parties. Concession-making may involve giving up negotiator's utility and is an essential activity in the negotiation process. In the past it has been suggested by some authors that negotiators utility functions over the issues may not be linear. In this case, a phenomenon called "concession crossover" takes place, in which a negotiator may switch issues on which they choose to make concessions at some point in negotiations. This work sets to investigate the validity of such claims. To this end we introduce several concession-making models and use them for testing hypotheses. We have used a dataset from online negotiation experiments featuring a contract-signing case. The results support the claim that concession crossover does indeed occur.

Keywords: electronic negotiations, concession making, concession crossover

1. Introduction

Negotiation has been described as a joint decision making process involving making concessions by the parties, while concession has been defined as "a change of offer in the supposed direction of the other party's interests that reduces the level of benefit sought" (Pruitt, 1981). Concession making behavior, exhibited by participants in the negotiation process, has a significant effect on the outcomes of negotiations (see Kersten, Vahidov and Gimon, 2013). The studies of the concession making patterns in negotiations help not only in advancing our understanding of the negotiator behavior, but also in building effective tools for assisting negotiators in making informed offer-making decisions, especially in cases where negotiations take place over electronic media (Carbonneau, Kersten and Vahidov, 2008, 2011). Such support tools can be seamlessly embedded within electronic negotiation systems (ENS), thus providing organic support for the human participants.

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In case of single-issue negotiations concession-making obviously occurs on a single dimension with parties having strictly opposite interests. In this case the magnitude of the next concession and the rate of concession making are the most notable variables of interest. When multiple issues are included in the offer exchange, there is always a possibility that the parties will have differing preferences across the issues. Therefore, the parties have more space for maneuvering in their exploration process in search of the mutually acceptable solutions. In this case, there is always uncertainty as per which issue(s) a negotiator will choose next to concede on.

In cases where issues have approximately equally spaced option values (e.g. 1 year, 2 years, and 3 years for warranty), the linear model of negotiator's utility assumes that the utility values of those options are also equally spaced. In other words, going from one option to the next level results in the same utility difference regardless of the current option level. For the above example, if we take issue utility to be 0 at the minimum, and 100 for the maximum, then for the buyer 3 year warranty would be the most preferred value (100), and 1 year would be the worst. Going from 3 years to 2 years, as well as going from 2 years to 1 would mean the same loss of 50 in utility. Northcraft, Brodt and Neale (1995) showed that in such a model a negotiator will always choose to concede on the same issue. Based on the principle of diminishing marginal utility, they have proposed an alternative model, where the utility functions are non-linear. They have shown that in such a model a phenomenon they called "concession crossover" may occur. Concession crossover occurs when a negotiator decides to switch from one issue to another, while making concessions, because making further concessions on the first issue results in larger utility loss than a concession on the second issue. This may occur only if utility functions over the issues are non-linear.

The current work attempts to empirically investigate the presence of the concession crossover. It uses a large dataset, obtained from the experiments involving electronic negotiations. Using online negotiation settings instead of face-to-face has at least two advantages. First, we are able to accumulate a lot of observations, as negotiations can take place between the spatially and temporally separated parties. Second, the asynchronous nature of negotiations allows parties to make thought-through decisions, while avoiding the pressures of time allotted for the completion of the experiment, as well as psychological factors that are present in face-to-face synchronous negotiations.

The remainder of the paper is organized as follows. The next section covers background work, in particular – the studies related to concession crossover. The subsequent section elaborates on the phenomenon of crossover as it applies to negotiations, including cases where issues have different numbers of option values. We then proceed to propose alternative models of concession-making behavior in order to test our expectations. The next section states research hypotheses for testing the actual occurrence of concession crossover based on the experimental data. The negotiation case and experimental settings are introduced in the subsequent section, followed by the results, and the conclusion sections.

2. Background

Including multiple issues in negotiations provides the participants with an opportunity of exploring more beneficial joint solutions, as opposed to the distributive mode, within which the parties' objectives are directly opposed to each other (Kersten and Noronha, 1999). This is due to the high likelihood that the negotiators' preferences over the issues will be different to some extent. As the parties' preferences are kept private in many negotiations involving businesses, as well as individuals, concessions made by one party may be perceived differently by the other party, depending on the latter's preference structure.

A classification of moves in bilateral multi-issue negotiations has been proposed by Filzmoser and Vetschera (2008). Starting with seven different moves negotiators could make at each step (combinations of up, down, and no change) the authors have derived the types of moves, including: concession, where negotiator gives up on utility; trade-off, whereby some issue values are raised, while some other issue values are lowered; insistence, where nothing is changed in two consequent offers, and demand, where negotiator increases some issue values, without making any concessions. One of the main findings based on an experimental dataset suggested that making trade-offs leads to higher agreement rates as opposed to making no trade-offs. In Kersten, Vahidov and Gimon (2013) the authors have proposed another model for classifying concessions in making offers applicable to both multi-issue negotiations and multi-attribute auctions. In this work the participants' preferences have also been included in the classification. They have identified four types of concessions, including win-win, win-lose, lose-win, and lose-lose.

Hence, exchanging offers is essentially the way in which the counterparts "probe" for the possible agreements. A negotiator may decide to make a large concession on one issue, which may turn out to be of little value to the opponent, or, conversely, a small concession on the other value may land a deal. For example, logrolling refers to the attempts at making concessions on less important issues in order to obtain gains on more important ones (see Moran and Ritov, 2002; Tajima and Fraser, 2001).

An important question in understanding negotiation behavior is whether the value (utility) of the next concession on a given issue to the party will change depending on the current issue level. The linear utility model assumes that equally spaced concessions result in equal utility drops. If this is not true, the implication is that the importance of the issue effectively depends on how much the party has already conceded on that issue.

Northcraft, Brodt and Neale (1995) hypothesised that in many cases actual utility functions, reflecting human preferences, are non-linear. They relied on the law of diminishing marginal utility to support their insight. The phenomenon of diminishing marginal utility has long been studied in economics (see, e.g., Stigler, 1950). Also known as Gossen's first law, it states that increase in consumption of a good leads to decrease of its marginal utility (Gossen, 1983). It was noted by Ng (1997) that there are neurological reasons for the law of diminishing marginal utility as the brain imposes mechanism to prevent excessive pleasure induced by the signals arriving from the peripheral system.

The law of diminishing marginal utility has been supported at a macro level as past studies looked to correlate economic indicators with the general reported happiness of populations. Based on data sets that measured happiness levels vs. Gross National Product per capita, Veenhoven (1991) concluded that there was a positive relationship. He also showed a curvilinear pattern providing evidence that marginal happiness is decreasing with the increase of per capita GNP. In one recent study, involving data collected from a number of countries, the elasticities of marginal utility of income were measured and were found to be similar across these countries (Layard, Mayraz and Nickel (2008).

Furthermore, according to prospect theory, the regions of non-linearity in utility are formed around the reference points dividing the regions of losses and gains (see Kahneman and Tversky, 1979). Northcraft et al. (1998) argued that non-linearities in utility curves may be formed because of the contextual factors, even if the person's actual utility function is linear.

Under linear model, a negotiator would always prefer to obtain gains on the most important issue. However, under non-linear model, it is quite possible that there would be a point, starting from which the marginal gains on a previously less important issue will equal (and thereafter exceed) those on the more important one. That point is where negotiation crossover occurs. The authors describe the phenomenon as a concession paradox, whereby gains in a less important issue becomes preferable. Mumpower (1991) considered the possibilities of negotiators having different types (shapes) of utility functions for issues: concave, convex, and linear. Based on these shapes, and assuming two-issue bilateral negotiations, six possible cases that resulted in different settlement spaces for negotiators had been identified. No claims have been made regarding the actual prevalence of any particular case over others.

The present study uses online negotiation experiment data in order to empirically examine concession crossover occurrence. The experimental setup and the negotiation case will be discussed further in the paper, but it is worthwhile to note that the preferences for the subjects over the issues were not directly specified, which allowed them to form their own opinions (Kersten, Roszkowska and Wachowicz, 2016; Roszkowska and Wachowicz, 2015). Electronic negotiation systems (ENS) allow parties to interact without the need for them to be in the same place, at the same time. Negotiators can manage the exchange of offers and messages, while the used system can provide analytical and graphical support in the process. Examples of ENS reported in the past include SimpleNS, a system that lets users exchange offers and messages online (Kersten and Lai, 2010), WebNS that allows a richer interaction between parties (Yuan, 2003), and Negoisst that can manage message and document exchange (Schoop, Jertila and List, 2003).

The ENS used in current experiments is Inspire (Kersten and Noronha, 1999), implemented on the so called ENS platform Invite (Kersten and Lai, 2010). The system is built around three phases of pre-negotiation, negotiation, and post-negotiation. In pre-negotiation phase the system allows users to prepare and specify their preferences in terms of issue and option ratings. In the course of negotiations the users can exchange offers and messages. In post-negotiations the system may offer users some alternate solution to consider if it finds one superior to the user agreement.

3. Preference non-linearity

As mentioned earlier, the diminishing marginal utility implies that the additional pleasure from gaining more of a given good reduces as the amount of that good consumed grows. From the negotiation perspective, a party first makes an offer that is beneficial for her, and may subsequently change the offer by giving up on an issue, thus lowering her utility. Consider, for example, a hypothetical situation where an organization wants to buy a certain number of tablet computers and negotiates with the seller on two issues: Price and Warranty. Table 1 shows the summary of issue levels and utilities. For convenience, issue levels have been normalized, so that the first issue value is assigned 0, and the last one is assigned 1, the rest are assigned discrete values within the unit interval.

Table 1. Issues with linear utility functions

Normalized issue level	Price	Utility	Warranty	Utility
0	\$500	0.6	1 year	0.4
0.25	\$525	0.45	2 years	0.3
0.5	\$550	0.3	3 years	0.2
0.75	\$575	0.15	4 years	0.1
1	\$600	0	5 years	0

Here we assume that the total utility of the best offer is 1 (one can also use the scale from 0 to 100; the choice of the unity here is arbitrary). Price is considered a more important issue than warranty (we are adopting a buyer's perspective here), because the utility for the price goes up to 0.6. The table assumes linear utility functions, which are shown graphically on Fig. 1.

The best offer for the buyer would be Price = \$500, Warranty = 5 years. When faced with the necessity to make concession from this ideal position, in the linear model the choices would imply dropping 0.1 utils if conceding on warranty, vs. 0.15 if conceding on price. Therefore, a buyer would concede on warranty. From this position on, the buyer will again choose the same issue for the next concession as these values for drop in utility will be constant. Only after finishing up all options on warranty (1 year), in the absence of the agreement, the buyer would choose another issue.

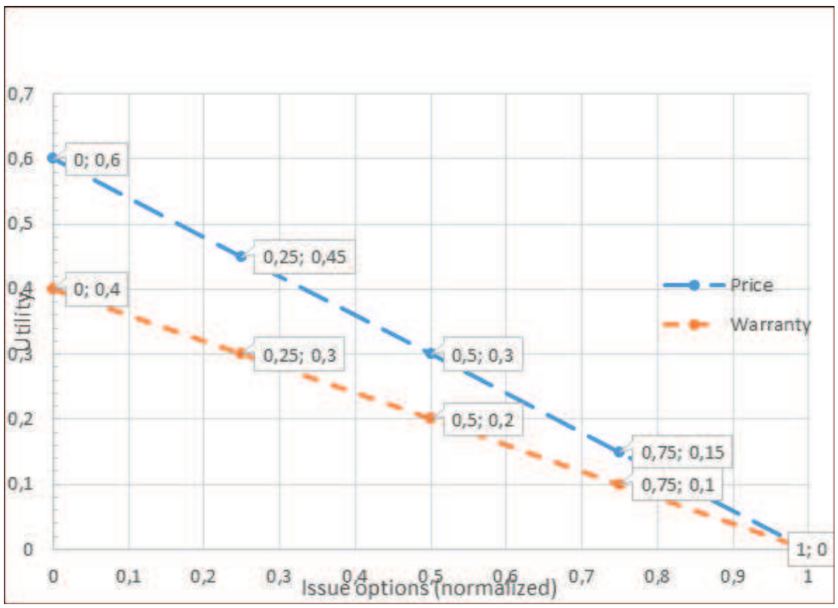

Figure 1. Linear utility functions

The model described assumed equal number of options for issues. What if the numbers of options are different? Assume, for example, that there are three levels for warranty (Table 2).

Table 2. Issues with linear utility functions and different numbers of options

Normalized issue level	Price	Utility	Warranty	Utility
0	\$500	0.6	1 year	0.4
0.25	\$525	0.45	N/A	N/A
0.5	\$550	0.3	3 years	0.2
0.75	\$575	0.15	N/A	N/A
1	\$600	0	5 years	0

Figure 2 shows the issue utilities graphically. As one can see, now the drop in utility for warranty constitutes 0.2, as compared to 0.15 for the Price. Therefore, somewhat paradoxically, the buyer will choose to concede on price all the way, despite the fact that price is seen as a more important issue. To make the picture more dramatic, assume that the smallest amount to concede at every step in negotiation is a penny. Paying a penny less means almost nothing to the buyer when compared to going from 1 year to 3 years of warranty. Thus, at any step under the linearity assumption, the buyer could concede a penny in a new offer, until all the price potential is gone (this is, of course assuming negotiators have all the time in the world). Whether the number of options per issue is the same or not, the important point is that under linearity assumption, the negotiator will keep on conceding on the same issue to the end, and crossover will never occur.

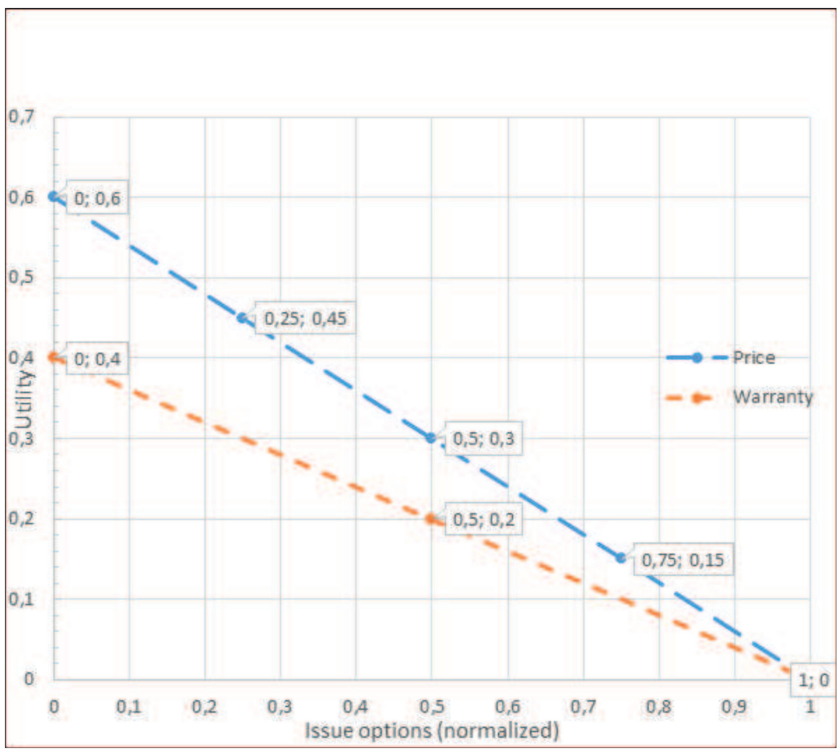

Figure 2. Linear utility functions with differing numbers of options

Now, let us assume that the issue utilities are not following a linear trend, to be precise – let us say they are as shown in Table 3 and in Fig. 3.

As one can see from the table, now the drop in utility changes when moving from one level to the next one. Roughly speaking, giving up the first chunk on some issue is not as drastic as giving up the last chunk. In this example, initially the buyer would make a concession on warranty, as the drop of 0.04 is less than a potential drop of 0.06 if price is picked (offer: Price = \$500, Warranty = 4 years).

Table 3. Issues with nonlinear utility functions

Normalized issue level	Price	Utility	Utility drop	Warranty	Utility	Utility drop
0	$500	0.6	0.00	1 year	0.4	0.00
0.25	$525	0.54	0.06	2 years	0.3	0.04
0.5	$550	0.42	0.12	3 years	0.2	0.08
0.75	$575	0.24	0.18	4 years	0.1	0.12
1	$600	0	0.24	5 years	0	0.16

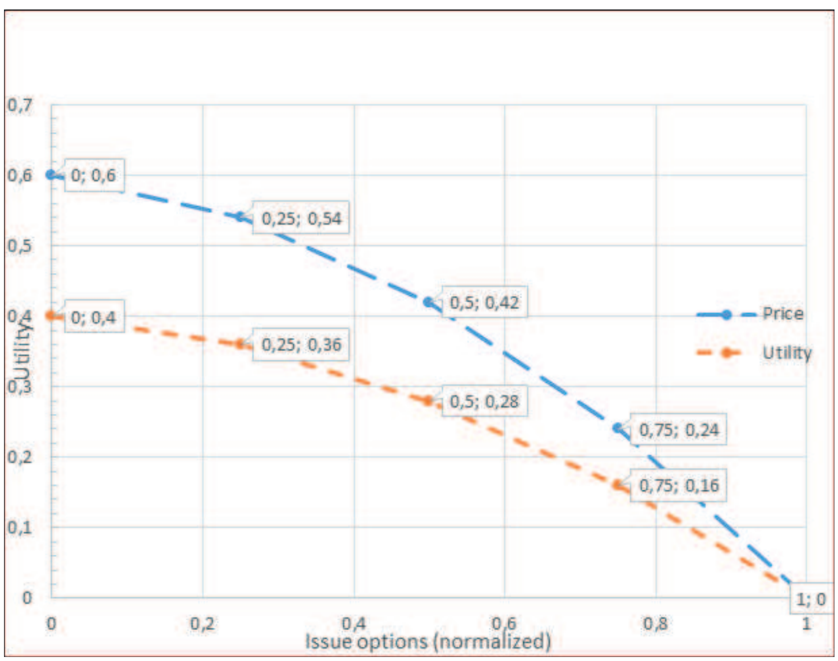

Figure 3. Issues with non-linear utility functions

Next, however, further concession on warranty means the drop of 0.08, which is more than 0.06. Therefore, this time, price will be picked, and this is where the concession crossover occurs (offer: Price = \$525, Warranty = 4 years). In the following sections we will introduce models we will be using in order to detect the occurrence of concession crossover, and thus establish the non-linearity of preferences based on a data set from online negotiation experiments.

4. Models

A number of simple concession-making models has been introduced in Carbonneau, Vahidov and Kersten (2014). We will adopt some of those as they fit the objective of the current study. We propose a series of tests to detect non-linearity of issue preferences as exhibited through concessions and concession crossover. Even though one may ask negotiators to explicitly define their preferences, the true measure of preferences is expressed by the actual concessions made in the process of negotiations. Although a negotiator may make offers based on a strategy designed to send false signals, each offer can potentially be accepted by the counterpart, thus there is a significant intrinsic incentive to make offers that closely follow the negotiator's true preferences.

For a specific negotiator in a negotiation session, let us denote the total number of issues as I and the total number of offers as F (we choose F instead of O for offers to avoid confusion with the number 0). Each offer $(f \epsilon \{1, ..., F\})$ contains values (options, levels) v_{if} for each issue $(i \epsilon \{1, ..., I\})$. The values will range between the minimum and maximum limits for an issue $(d_i = max\,(v_i) - min(v_i))$. A concession $(\Delta v_{if} = v_{if} - v_{i(f-1)})$ is made when the value of an issue for the current offer is lower than the value of the issue in the previous offer. For modeling purposes, issue ranges can be inversed or re-ordered when required, so that they follow the same direction as utility, meaning a larger number is better for the negotiator. Thus, we always model from the perspective of maximizing utility.

For a given issue, we can calculate the remaining concession potential as:

$$p_{if} = \frac{(v_{if} - min\,(v_i))}{d_i}. \tag{1}$$

The baseline model, used for the analysis here, is the *Random model.* In this model, the assumption is that a negotiator randomly picks an issue for concession-making at each step. A good predictive model must fit the data better than this baseline.

The random model simply indicates that the negotiator has no preference difference between issues and chooses a random issue to concede on at every step. At each step the model chooses an issue to concede on completely randomly (i.e. from uniform distribution) from among the issues, for which concession is still possible. The model has no memory and its selection does not depend on previous choices (other than previous choices having restricted the selection if some issues run out of the remaining potential concessions). A negotiator who adopts the random model will behave as follows:

Let r be a random issue in the set $\{1, ..., I\}$

$$(i = r \wedge p_{if} > 0) \rightarrow (\Delta v_{if} < 0) \quad \forall f, \forall i. \tag{2}$$

As we have seen, the linearity of issue utility functions implies that the negotiator will concede on the least preferred issue until there is nothing left to concede. Even if the counterpart has conceded on the negotiator's least preferred issue, the negotiator will still be willing to concede beyond the counterpart's offer since any other issue concession will result in larger utility loss.

This is translated into the *Naive model*: a negotiator, who adopts a linear utility model, will behave as follows:

$$\left(\Delta v_{i(f-1)} < 0 \wedge p_{if} > 0\right) \rightarrow (\Delta v_{if} < 0) \quad \forall f, \forall i. \tag{3}$$

The first and the simplest model that can be used to test for concession crossover is what we call the anti-naive model. In this model the next issue to concede on will be any issue other than the issue that was last conceded on, for which there is remaining potential to concede on.

Anti-Naive model: Concessions will be made as follows:

$$\left(i = r \wedge \Delta v_{i(f-1)} \geq 0 \wedge p_{if} > 0\right) \rightarrow (\Delta v_{if} < 0) \quad \forall f, \forall i. \tag{4}$$

Here, again, r is a random number. In other words, an issue is picked randomly from the set of issues with concession potential remaining and excluding the one that was picked last time. The model is used here to detect the occurrence of crossover.

A more refined model for explaining concession crossover considers how much of the concession-making potential remains in each issue. The next issue for concession would be the one with the most of the remaining concession potential. In essence, this model not only can detect crossover occurrence, but goes further. It is based on the idea of diminishing marginal utility. In other words, it picks the issue, on which there is still a lot to give up, and the drop in utility is not so drastic.

Max-Potential model: Concessions will be made as follows:

$$\left(i = argmax_{j \in \{1...I\}} \left(p_{if}\right) \wedge p_{if} > 0\right) \rightarrow (\Delta v_{if} < 0) \quad \forall f, \forall i. \tag{5}$$

5. Hypotheses

Our basic expectations are two-fold: 1) concession crossover occurs, and 2) Max-potential model explains concession crossover better than other models. Thus, we propose the following hypotheses.

H1: The Random model (Equation 2) will significantly outperform the Naive model (3) in predicting the next concession issue.

Linear utility assumption implies that the Naïve model should do significantly better than the random one. Our expectation is that switching between the issues, even using random choice should do a better job at predicting the next issue, than the Naive model, which prohibits any switching, as long as there is a potential concession remaining on a given issue.

The Anti-naive model will be the first test effect for detecting the concession crossover.

H2: The Anti-Naive model (4) will significantly outperform the Random model (2) in predicting the next concession issue.

The second non-linear sequence model is the Max-Potential concession model, which specifies that the next concession will be on the issue with the most of the remaining potential.

H3: The Max-Potential model (5) will significantly outperform the random model (2) in predicting the next concession issue.

Since we may have two different concession crossover models that explain the data, we will compare the performance of the Max-Potential model to the Anti-Naive model. Essentially, the next hypothesis implies that negotiators tend to choose next moves in accordance with the law of diminishing marginal utility, rather than randomly switching to any other issue to concede on.

H4: The Max-Potential model (5) will significantly outperform the Anti-Naive model (4) in predicting the next concession issue.

6. Experimental setup

The dataset, used in the study, comes from online bilateral negotiation experiments conducted regularly in the last 10 years and contains records collected from over 2 000 subjects. The negotiation case is about signing a contract between a music company and a musician. In the case a singer, Ms. Sonata wants to sign a contract with a major entertainment agency. Her agent, Fado, is involved in actual contract negotiation. The representative of one of the major entertainment companies (named WorldMusic), Mosico, is the other party in negotiations. The negotiated issues include the number of new songs (songs), royalties for CDs (royalties), contract signing bonus (bonus), and number of promotional concerts (concerts). No exact preference information was given to the subjects, but the relative issue importance and utility values were shown graphically. The case has been described elsewhere in more detail, e.g. in Kersten, Roszkowska and Wachowicz (2015). The summary of issues and option values is shown in Table 4. The utility comparisons among the issues and options for the parties are shown in Table 5.

Table 4. Summary of negotiation issues

Issues	Number of concerts (NC)	Number of new songs (NS)	Royalties for CDs (CD), %	Contract signing bonus (SB), $1000
Options	5	11	1.5	125
	6	12	2.0	150
	7	13	2.5	200
	8	14	3.0	N/A
	N/A	15	N/A	N/A

Table 5. Utility comparisons

Issues/options	*Artist*	*Music company*
Issues	U(NC) = U(NS) >U(SB) >U(CD)	U(NC) >U(NS) >U(CD) >U(SB)
Number of concerts	U(5) >U(6) >U(7) >U(8)	U(8) >U(7) >U(6) >U(5)
Number of new songs	U(14) >U(15) >U(13) >U(12) >U(11)	U(14) >U(15) >U(13) >U(12) >U(11)
Royalties for CDs	U(3) >U(2.5) >U(2) >U(1.5)	U(2) >U(2.5) >U(1.5) >U(3)
Contract signing bonus	U(200) >U(150) >U(125)	U(125) >U(150) >U(200)

Because the negotiation issues had different numbers of predefined option levels, there are more concessions made on issues with more option levels. For example, the number of concerts has four option levels, the number of songs has five, the royalties have four, and bonus has three. Therefore, there will be more concession occurrences on the number of songs, simply because there are more levels. We could simply predict that this would be the next issue to concede on and it would fit the data better than the Random model. However, since none of our models is issue specific, this has no impact on the tests. In addition, since the Random model is the baseline, and not simply a 25% (1 in 4 issues) prediction rate, any impact of an overall issue bias on the results is completely avoided.

The dataset used in the study comes from online bilateral negotiation experiments conducted regularly between 2010 and 2016 with student subjects. In total, 2 229 individual observations were obtained. The reported ages of the majority of subjects (i.e., 93%) were between 20 and 30 years. The composition of the data in the chronological order is reported in Table 6. The dataset of each online experiment is further decomposed according to genders. In overall, the number of female participants is slightly higher than that of male participants.

Table 6. Online experiment numbers: breakdown by the year and gender

Experiment		**Gender**		
		Female	Male	Missing
2010/12	247	121	118	8
2011/05	233	62	87	84
2011/10	184	80	104	0
2012/04	134	78	56	0
2013/04	248	119	129	0
2013/11	157	78	79	0
2014/04	340	194	146	0
2014/11	80	42	38	0
2015/04	298	173	125	0
2015/11	80	35	45	0
2016/04	228	138	90	0
Total	2229	1120	1017	92

The participants in this dataset registered to our online experiments from eleven countries, in which their associated education institutions were based. The composition of the dataset based on countries is reported in Table 7. The countries are further aggregated into five larger areas, including Asia, Europe, Middle East, and North America.

Table 7. Breakdown by country and area

Country	Number	Area	Number
P.R. China (CN)	94	Asia	316
Taiwan (TW)	222		
Austria (AT)	585	Europe	1787
Switzerland (CH)	77		
United Kingdom (GB)	41		
Netherlands (NL)	9		
Poland (PL)	1022		
Ukraine (UA)	53		
Palestine (PS)	22	Middle East	22
United States (US)	42	North America	104
Canada (CA)	62		

7. Results

Since the models evaluate the next concession based on the previous concessions, at least two offers are required from a negotiator. The subjects, who sent only one offer have been excluded from the analysis. After filtering, there were 9 024 offers in the Music negotiation case that were used for hypothesis testing. The results are presented below:

In order to test Hypothesis 1, we compared the Naive model versus the Random model. Since a negotiator may have conceded on more than one issue at the same time, only one of such concession issues was chosen randomly to provide a fair comparison. The Random model had an average fit of 18.01%, while the Naive model had an average fit of 7.05%. The reason why the Random model did not produce close to $\frac{1}{4}$ accuracy, is because of the different numbers of options in the issues, and different preference structures adopted by the subjects. The difference between the two means is highly significant (p-value 0.000), and, thus, H1 has been supported.

The Anti-Naive model randomly selects one of the multiple issues with remaining concession potential that did not have a concession in the last offer. The average prediction accuracy of the Anti-Naive model is 21.55% versus 18.01% for the Random model. Thus, the Anti-Naive model fits the negotiator's concession-making behavior better than the Random model with the difference between the two means being highly significant. Therefore, Hypothesis 2 has been supported with the p-value of 0.000.

The average prediction accuracy of the Max-Potential model is 25.69%, which is higher than 18.01% for the Random model. Thus, the Max-Potential model fits the negotiators selection of issue sequence to concede by 42.65% better than the Random model with the difference between the two means being again highly significant. Hence, Hypothesis 3 has been supported with the p-value of 0.000.

Furthermore, the average fit of the Max-Potential model is 25.69%, which is higher than 21.55% for the Anti-Naive model. Thus, the Max-Potential model fits the negotiators preferences by 19.18% better than the Anti-Naive model. The difference between the two means is highly significant with the p-value of 0.000. Therefore, Hypothesis 4 has also been supported.

8. Conclusion

The purpose of this work was to demonstrate that the phenomenon of concession crossover does occur in online negotiations involving multiple issues. To this end we have used experimental data collected over the years and containing records of bilateral negotiations featuring a contract signing case. Four concession prediction models have been utilized for testing the crossover effect.

The Naïve model has been used as a proxy for the linear utility assumption as it would predict making concessions on the same issue repeatedly until all the options on the issue are used up. It was shown that a random model performs significantly better, thus beating the linearity of utility assumption. Further, the Anti-Naïve model specifically forbade making concessions repeatedly on the same issue, while making a random choice among the remaining issues. Thus, the model acted in opposition to the linearity assumption, and was shown to perform better than a random model. The Max-potential model dictated the choice of the next issue based on how much potential remains. Thus, it was implicitly based on the diminishing marginal utility assumption, and proved to perform significantly better than any other model. Therefore, there is a clear evidence in support of the concession crossover argument.

While the accuracy of prediction does not seem to be particularly impressive, note that prediction accuracy has not been our objective per se. The simple models used in this work were employed (successfully) to detect concession crossover phenomenon. Another concern could be raised in regards to the sample size, and hence the tests being too powerful. However, the magnitude of the difference between the predictions of the models clearly show the superiority of all of them as compared with the linear Naïve model. Yet another criticism could be raised with respect to the treatment of all moves as “concessions”, thus ignoring the “trade-off” offers. However, no matter whether the offer was purely conceding or a trade-off (conceding on some, while looking for improvement on other issue) we aimed to show that switching between the concession issues occurs.

There are practical implications for negotiators from the current study. The findings suggest that negotiators should reasonably expect their counterparts to switch issues while making concessions at some point and be prepared for this. Furthermore, according to the max-potential model, they will pick the next issue which has the largest potential for making concessions. A negotiator may anticipate such a move and make a concession on a similar issue to minimize the distance to the agreement on that issue. The closer the parties' positions, the more likely that there will be an agreement between them.

One possible direction for the future work is to explore how to employ the occurrence of concession crossover to assist negotiators in the process of negotiations. For example, an ENS could suggest how to make a candidate offer more attractive to the opponent. Another possibility is to explore the intensity of crossovers as the number of issues in the negotiations changes. It would also be interesting to investigate if cultural background of negotiators has effects on concession-making.

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