



University
of Economics
in Katowice

Evaluating the eNego System: A Dual Perspective on Subjective Acceptation and Objective Scoring System Accuracy

Tomasz Wachowicz

University of Economics in Katowice, Poland

Ewa Roszkowska

Białystok University of Technology, Poland

GDN 2025, Zaragoza



Outline

- Motivation
- eNego - overview
- Analytical and experimental setups
- Results – objective and subjective evaluation of eNego
- Conclusions and future research

Motivation

Negotiation Support Systems / eNegotiation Systems

- Most negotiations are multi-issue; thus, **NSS/eNSS employ MCDA methods** to support Negotiation scoring and decision-making
- Using MCDA requires **accounting for users' cognitive capacities** and limitations, as even the simplest tools (e.g., direct rating) may trigger heuristics and biases such as:

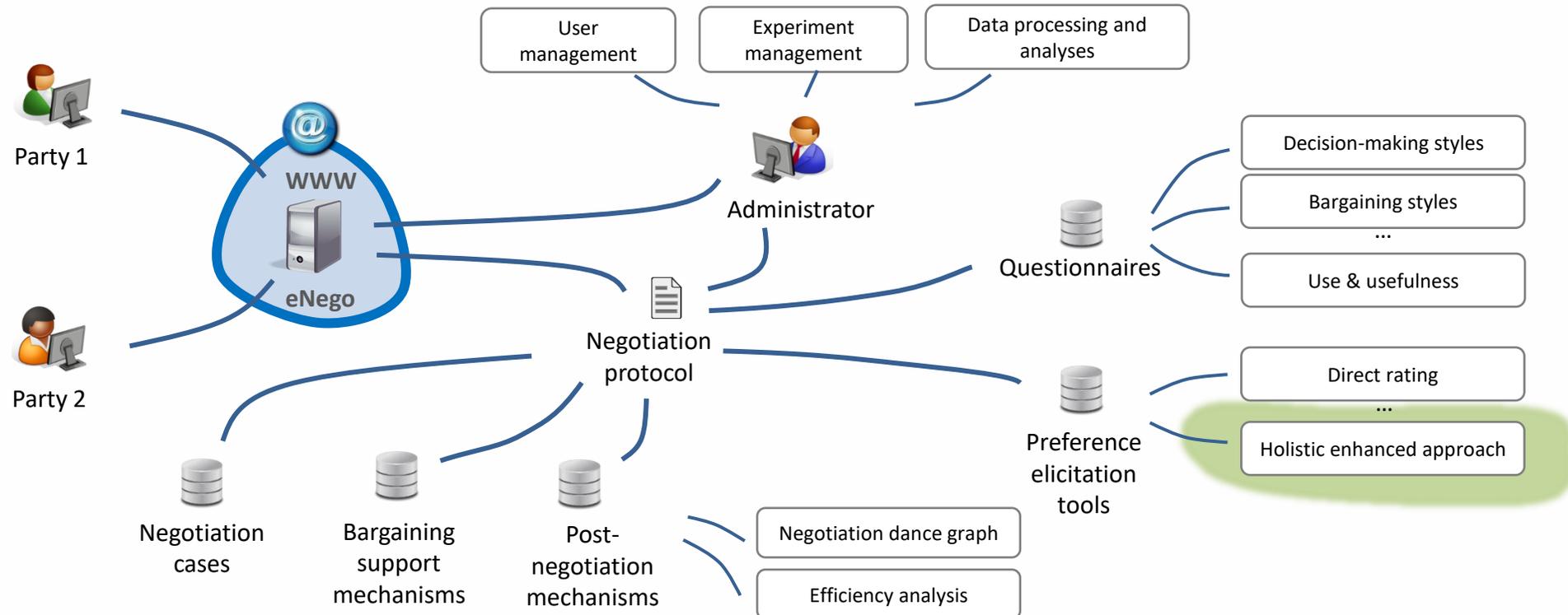
The goal of this study is to evaluate the **acceptance and use** of the eNego system with its holistic preference elicitation engine

- **central tendency bias** (Pimentel 2019; Roszkowska, Wachowicz 2022)
- To mitigate such effects, the **eNego** system was developed **using a holistic prenegotiation protocol** based on the disaggregation–aggregation paradigm (Wachowicz, Roszkowska 2021)
- This holistic approach is seen as **less cognitively demanding**, as it asks decision-makers to **compare complete alternatives**, making the task more intuitive than evaluating abstract options without context (Corrente et al. 2013)

eNego

Overview

- eNego is a **research and training** system (Kersten, Lai 2021) designed to facilitate bilateral, multi-issue negotiations in pre-, actual-, and post-negotiation phases.



eNego

Holistic enhanced prenegotiation protocol

- eNego employs a hybrid holistic **four-step iterative procedure** for pre-negotiation preference elicitation, combining disaggregation (UTA + MARS + preference non-monotonicity mechanisms) with manual fine-tuning (Wachowicz and Roszkowska 2021; 2022):
 1. **Calibrating scoring system:** Defining the best and worst options for each issue to confirm the monotonicity of preferences for option sub-ranges.
 2. **Ranking reference offers:** Organizing MARS-based reference alternatives in descending order of preference, utilizing a simple drag-and-drop interface for clarity and ease.
 3. **Tuning template ratings:** Adjusting scores using a modified UTA model. Ratings are refined iteratively, and inconsistencies are resolved to ensure coherent alignment of preferences.
 4. **Aggregating and verifying scores:** Analysing global scores of selected offers and verifying that the rankings reflect the true quality of preferences. Further refinements are made as needed to ensure accuracy and user satisfaction.

Evaluating eNego system

Subjective view

- The subjective evaluation of eNego acceptance is based on data collected through an **online questionnaire comprising seven questions** rated on a 7-point Likert scale (1 = strongly agree, 7 = strongly disagree) inspired by TAM (Davis 1986):
 - V1: The entire preference elicitation process in eNego was **cumbersome and time-consuming**
 - V2: It was **difficult** for me to build a ranking using the predefined alternatives
 - V3: The set of predefined alternatives was **too numerous**
 - V4: If I had the option, **I would use a different set of alternatives** for comparison
 - V5: The interface that required dragging and dropping boxes with offers was **unintuitive and inefficient**
 - V6: The scoring system determined by UTA **did not accurately reflect** my principal's preferences
 - V7: I would prefer to assign the issue and option ratings myself just from the very beginning, **without any preceding holistic declarations** of rankings of exemplary offers

Evaluating eNego system

Objective view

- The objective evaluation uses data recorded by eNego that describe the user's actions during the prenegotiation phase:
 - **Number of Changes (NC)**: The number of modifications made to the initial UTA-generated negotiation scoring system (number of repetitions of steps 2 and 3)
 - **Accuracy First (AF)**: The accuracy of the scoring system initially generated by users through holistic algorithm
 - **Accuracy Last (AL)**: The accuracy of the final scoring system after all modifications made by users
- The accuracy of negotiator's scoring system \mathcal{S}_T^N was measured using **cardinal inaccuracy index** (Wachowicz, Roszkowska, 2022)

$$CII(\mathcal{S}_T^N, \mathcal{S}_T^P) = \sum_{j=1}^n \sum_{k=1}^{n_j} \left| \tilde{v}_j^{Nk} - \tilde{v}_j^{Pk} \right|$$

where: \mathcal{S}_T^P is a reference scoring system (principal's)
 \tilde{v}_j^{Nk} (\tilde{v}_j^{Pk}) are ratings of corresponding template's elements in \mathcal{S}_T^N and \mathcal{S}_T^P

Evaluating eNego system

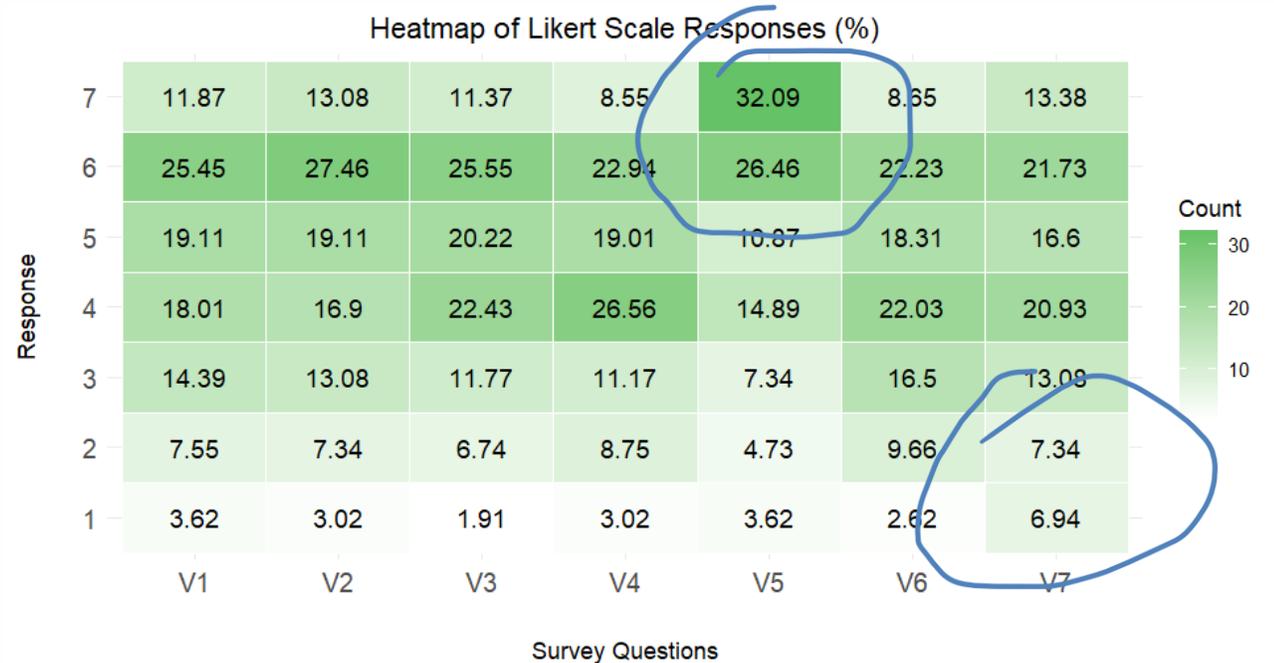
Negotiation experiment

- The online **negotiation experiment** was conducted within the eNego system, allowing participants to engage in a preference elicitation and ranking process
- A bilateral, **predefined negotiation scenario** was employed, as based on a negotiation template involving four issues with salient predefined options — an adapted version of the Mosico–Fado case from the Inspire system (Wachowicz et al., 2019)
- The experiments conducted within the eNego system took place **between 2018 and 2024**. The studies involved students from six Polish universities, yielding **994 valid records** after data cleaning
- Among the participants, **61.6% were male and 38.4% were female**. Their ages ranged from 18 to 50, with a mean age of 23 years (SD = 4.25)

Evaluating eNego system

1. Basic statistical analysis

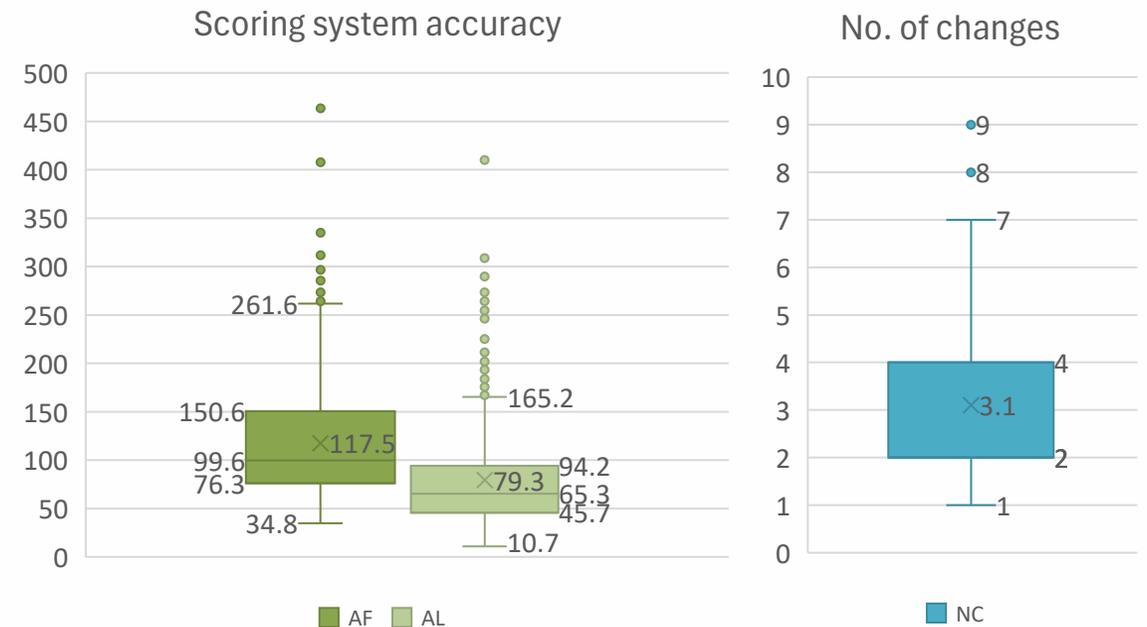
- **Over 30% of participants gave high scores (6 or 7)** for each item, reflecting positive views on various aspects of the eNego system
- **Less than 15% assigned low scores (1 or 2)**, indicating more negative assessments of the system
- **More than half** found the drag-and-drop interface intuitive and efficient (V5)
- In contrast, **nearly 15%** preferred to assign the issue and option ratings themselves (V7)
- Chi-squared test revealed statistical significance ($p < 0.001$) for all pairs, indicating a **strong relationship between responses** → various aspects of eNego were perceived interconnected



Evaluating eNego system

1. Basic statistical analysis

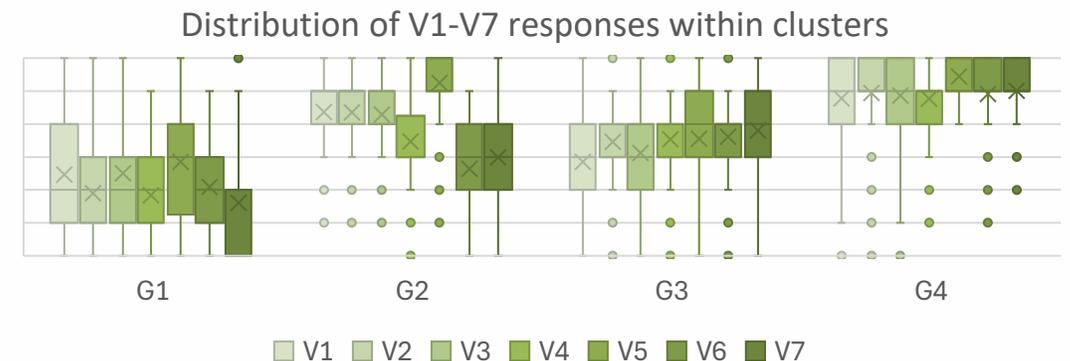
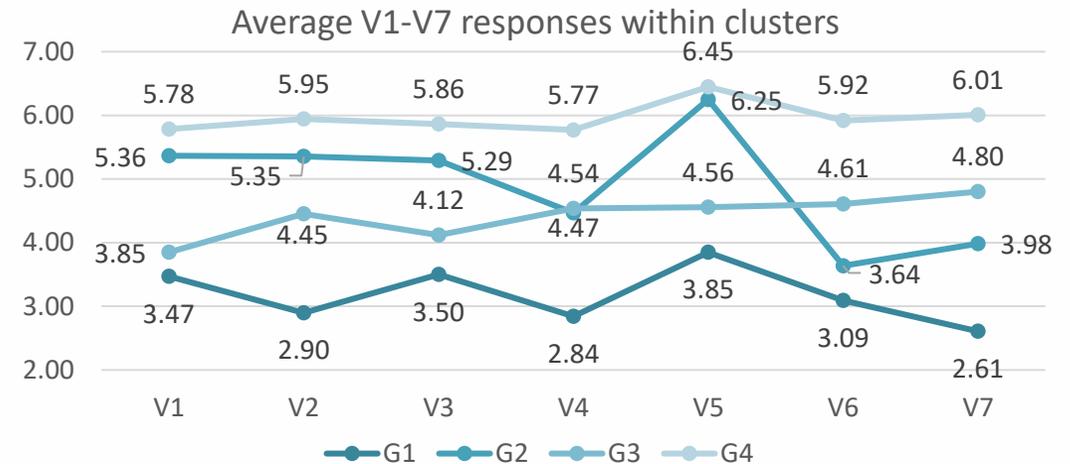
- CII values are scaled to $[0, +\infty]$ with:
 - 0 – perfect accuracy
 - 240 – accuracy of average random scoring system
- 3.1% (30) negotiators produced scoring systems **less accurate than the average** random system
- NC with a mean of 3.10 (SD = 1.90) reflects **moderate interaction** with the system
- After iterative improvements, the **inaccuracy of scoring system decreased** by nearly 40 points and reached 79.27 (SD = 50.19). The improvements are statistically significant ($p < 0.001$ in Wilcoxon test)



Evaluating eNego system

2. Identifying user profiles from k-Means Method

- Using the k-means, **four distinct profiles** of participants' evaluations of eNego were distinguished
- **Differences between profiles were significant** ($p < 0.003$ in Mann-Whitney test) for all pairs of items, except for:
 - V4 for G2-vs-G3 ($p = 0.68$) and
 - V5 for G2-vs-G4 ($p = 0.05$)
- The groups can be labeled:
 - G1 (N=196) „Least satisfied users”
 - G2 (N=226) „Ease of Use and Interface-Focused Users”
 - G3 (N=297) „Usefulness-Focused Functional Users”
 - G4 (N=297) „Enthusiastic Users”



Evaluating eNego system

3. Relationship between user profiles and scoring accuracy

- G1 demonstrated the **highest level of inconsistency** in the initial scoring system generated by holistic protocol (significantly worse form other groups – $p < 0.01$)
- The Mann-Whitney test showed a statistically **significant difference** ($p < 0.01$) **between G4 and G3**, but not between G2 and G4 ($p = 0.104$)
- As a result of the modifications made, **significant improvements in the system's consistency** (AL) were achieved within each group ($p < 0.001$ in Wilcoxon test)
- After adjustments, **no significant differences in AL** were observed between the groups ($p > 0.192$ in Mann-Whitney test)

Index	Least Satisfied (G1)	Ease of Use and Interface-Focused (G2)	Usefulness-Focused Functional (G3)	Enthusiastic (G4)
NC	3.26	3.45	2.92	2.90
AF	133.78	113.34	119.35	107.28
AL	87.59	75.62	79.60	75.99

Summary and Conclusions

- eNego's **pre-negotiation protocol**, allowing iterative improvement of the scoring system, **proved highly effective** → despite initial inaccuracies, the system facilitated significant improvements across all users
- **All groups of users ultimately achieved similar levels of accuracy** of the negotiation scoring system after the adjustments
- A clear **relationship was observed between initial inaccuracy and respondents' evaluations of the system** → those who rated the eNego system more positively demonstrated statistically significantly better accuracy in the initial negotiation scoring system
- Users from the group that **rated the system lowest (G1) made the highest number of adjustments**—possibly explaining their negative evaluation—as they likely had to invest more effort to reach a level of accuracy comparable to other groups (starting from the lowest baseline).

Limitations and future work

- The **usefulness of student samples** is a widely debated in empirical economics with no definitive conclusions. Yet, some research show that **students who received negotiation training** outperformed their untrained peers and **were not significantly outperformed by professional negotiators**
- More advanced evaluation models with extended evaluation dimensions (Innovation Diffusion Theory (IDT) or Unified Theory of Acceptance and Use of Technology 2 (UTAUT2)) could be employed in **comprehensive assessment of eNego**
- **Comparative studies** evaluating similar electronic negotiation environments (eNSs) would be of interest, as they could reveal the extent to which the overall system evaluation depends on its decision support components, UX design and other contextual elements
- Should users perform this preparatory work on their own? How would their **performance change** if they could **interactively collaborate with genAI** during prenegotiation preparation?



your place

your space



your future

University of Economics in Katowice