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# Framework of Behaviour Training in Digital Negotiations

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## Abstract

In order to act and to react effectively in (digital) negotiations, it is essential that negotiators recognise and apply diverse negotiation behaviour. However, there is a lack of research regarding IT-based training tools that support negotiators in implementing such behaviour. Consequently, training becomes essential for acquiring the skills to recognise and apply various negotiation approaches. Our objective is to enhance the accessibility of IT-based training for novice negotiators.

The training employs software agents capable of exhibiting different negotiation behaviour, thereby enabling negotiators to identify these patterns and respond appropriately during business negotiations. The training encompasses business negotiations with a variety of negotiation partners representing businesses. An artefact was designed and implemented in accordance with the principles and methodologies of design science research. The artefact underwent empirical evaluation through surveys, wherein negotiators identified specific displayed behaviour and reflected upon their individual learning outcomes. Despite the inherent complexity of negotiation behaviour training, novice negotiators were able to successfully recognise behaviour whilst maintaining a consistently high level of intrinsic motivation. Furthermore, the study demonstrated positive effects on learning outcomes.

**Keywords** Negotiation behaviour · Negotiation agents · Digital negotiation · Digital training · NSS

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## 1 Introduction

Digital negotiations are defined as communication and decision-making processes between at least two parties with divergent preferences, which create a conflict situation that cannot be resolved unilaterally. These parties exchange arguments (e.g. offers, counteroffers, questions, and clarifications) to resolve such conflicts (Bichler et al. 2003). Negotiation support systems (NSSs) have been shown to facilitate communication and/or decision-making tasks for negotiators by providing relevant information about the negotiation. However, these systems do not conduct negotiations autonomously on behalf of the negotiator (Bichler et al. 2003; Kersten and Lai 2007; Schoop et al. 2003).

The process of negotiating through NSSs requires a range of skills. Digital skills have been proven to be essential for the effective utilisation of information and communication technology (ICT) (Mitrovic 2010; van Laar et al. 2017). For instance, the use of ICT has been demonstrated to facilitate the exchange of information and the decision-making purposes (van Laar et al. 2017), whilst enabling conflict resolution through argument exchange (Bichler et al. 2003). Digital skills are imperative for the effective utilisation of NSSs to enhance negotiation processes through communication and decision-making. The appropriate utilisation of digital systems whilst possessing the requisite technological understanding of such systems demands multidisciplinary knowledge (Mitrovic 2010). Thus, effective negotiation requires a range of (multifaceted) skills (Roloff et al. 2003), including perspective-taking. The skill of perspective-taking enables negotiators to consider negotiations from their partner's viewpoint, enhancing efficiency whilst facilitating the achievement of more valuable agreements (Damen et al. 2020; Galinsky et al. 2008; Neale and Bazerman 1983). Since negotiators (sub)consciously apply and are exposed to a variety of negotiation behaviour, including strategies and tactics for specific contexts, and are required to respond to their partner's negotiation manoeuvres (e.g. in offers, counteroffers, questions, and clarifications), they must recognise the negotiation behaviour their partner employs. Novice negotiators may find this requirement particularly challenging (Meyer 2022); thus, training in negotiation skills, such as perspective-taking, is needed, as skills can be improved through negotiation simulations (Thompson 2022). Digital negotiation training (digital training) is defined as training conducted within a system that utilises digital media and is distinguished by its accessibility, independent of time and place (Greenwald et al. 2003; Kersten and Lai 2007; Lim et al. 2007). This training has been developed to facilitate self-directed learning for negotiators, allowing them to engage in the programme at their own schedule. Nevertheless, the issue of digital training facilitating novices' acquisition of diverse negotiation behaviour remains unaddressed, as NSSs focus on supporting general decision-making and communication. Our study addresses this gap by conceptualising, implementing, and evaluating digital training. The training has been designed to train novices in the recognition of various negotiation behaviour by supporting the application of different negotiation strategies and tactics (particularly the skill perspective-taking).

Since negotiation involves at least two parties (Lewicki et al. 2010b), negotiation training requires negotiation partners. Employing human negotiation partners during the training process can result in several challenges. This is attributable to the

fact that the competence, expertise, moods, emotions, and cultural background of a human negotiation partner may vary over time, thereby having an influence on negotiation dynamics (Adair and Brett 2004; Forgas 1998; Kopelman et al. 2006; Lewicki, Barry, and Saunders 2010a). Thus, negotiating with agents can be more advantageous for novices than engaging with humans (Gratch et al. 2016), as such digital partners afford opportunities to practise comprehensive negotiation traits within various negotiation styles. Novices require training across several negotiation behaviour, including diverse negotiation strategies and tactics. The concept of agents engaging in more realistic negotiations through, e.g., adaptive behaviour, taking the partner's preferences into account, anticipating future conduct when formulating offers, and providing guidance to novices, is not a novel concept (Baarslag et al. 2012; Baarslag et al. 2016; Bosse and Jonker, 2005; Gratch et al. 2015).

The following research questions have been formulated in order to investigate the effects of such training:

RQ 1: In what way does the designed digital training support novices in identifying negotiation behaviour?

RQ 2: Does the designed digital training motivate the trainees during training?

RQ 3: What is the effect of the designed digital training on the learning outcome of the novices?

RQ 4: Does additional training of the negotiation behaviour increase the correct identification of the agents' behaviour during the designed digital training?

## 2 Theoretical Background

This section establishes the theoretical foundation of negotiation phases, the framework of self-determination theory, the skill of perspective-taking, and negotiation behaviour, including styles, strategies, and tactics.

Negotiations can be divided into three phases: pre-negotiation, conduct of negotiation, and post-settlement (Kersten and Noronha 1999). The pre-negotiation phase encompasses preparation for the negotiation (Kersten and Noronha 1999), which includes planning, agenda setting and exploring the field (Braun et al. 2006), as well as negotiation training. The conduct of negotiation is characterised by the exchange of offers and the subsequent conclusion of the negotiation (Braun et al. 2006), which can result in either a successful or a failed outcome. The post-settlement phase is characterised by a process of evaluation and reflection upon the outcome, alongside consideration of potential improvements (Braun et al. 2006). As the present study is concerned with the training of negotiation behaviour, the pre-negotiation phase will be the primary focus.

### 2.1 Self-Determination Theory

In the process of designing training, pedagogical aspects must be considered, including the motivation of the trainees (Östlund 2017). Self-determination theory (SDT) offers a theoretical framework for the examination of human motivation and the investigation of how social contexts influence attitudes, values, motivation and behaviour

(Deci and Ryan 2012). According to SDT, humans possess needs for competence, autonomy, and relatedness “that are essential for optimal development and functioning.” (Deci and Ryan 2012, p. 417). The SDT comprises several sub-theories, which explain various motivational phenomena. One of these sub-theories is the cognitive evaluation theory, which examines the effects of external factors in social contexts on intrinsic motivation (Center for Self-Determination Theory; Deci and Ryan 2012).

The Intrinsic Motivation Inventory (IMI) was developed based on the cognitive evaluation theory and is introduced by Ryan and colleagues (Deci and Ryan 1985; Plant and Ryan 1985; Ryan 1982; Ryan et al. 1983; Tsigilis and Theodosiou 2003). IMI has been extensively utilised as a measure of intrinsic motivation in exercises, and was thus developed for the purpose of assessing humans and their experiences in laboratory experiments. The model comprises seven categories, namely interest-enjoyment, perceived competence, effort/importance, pressure/tension, perceived freedom of choice, value/usefulness, and relatedness. Interest-enjoyment is the only category that addresses intrinsic motivation. Perceived competence and perceived freedom of choice measure positive behavioural and self-report indicators of intrinsic motivation, whilst pressure/tension measures a negative indicator of intrinsic motivation. Effort/importance measures self-report indicators of the effort humans put into the activity. Values/usefulness measures self-report indicators of how humans evaluate the activity as being useful within a specific context, and relatedness examines interpersonal interactions by measuring the relationship between the interacting humans (Center for Self-Determination Theory; Deci and Ryan 1985). In our work, we use IMI to assess whether the designed digital training motivates the trainees.

## 2.2 The Role of Perspective-Taking in Negotiations

As perspective-taking is defined as the capacity of an individual to view situations from the others' viewpoints and anticipate their behaviour to enhance interpersonal relationships (Davis 1983), this is particularly important in negotiations (Damen et al. 2020; Neale and Bazerman 1983). The ability to understand the partner's perspective increases the likelihood of making convincing offers and reaching mutually satisfactory agreements (Lewicki, Barry and Saunders 2010a). In order to gain a deeper insight into their partner's perspective, negotiators have to be able to recognise and interpret their partner's behaviour. Those who employ perspective taking have been shown to experience several advantages, such as diminished egocentric perceptions regarding fairness and reduced anchoring effects from the partner's offer (Galinsky et al. 2008). Given that perspective-taking can be learned (Damen et al. 2020; Galinsky et al. 2008; Neale and Bazerman 1983), it warrants inclusion in negotiation training for negotiation behaviour.

## 2.3 Negotiation Styles, Strategies, and Tactics

Negotiators aim to achieve their goals during the negotiation. In the pre-negotiation phase, they prepare how they want to behave during the negotiation by employing various strategies and tactics (Lewicki et al. 2010b). The current section delineates the relationship between negotiation styles, strategies, and tactics.

Negotiation styles are defined as orientations that specify how an individual can negotiate, and are characterised by the extent to which the outcome and the relationship with the partner are prioritised (Loewenstein and Thompson 2006). Negotiation strategies are defined as plans of action that delineate the manner in which negotiators intend to engage during the ongoing negotiation. The primary focus of this process is the selection and continuous reassessment of preferences. Negotiation tactics represent techniques for implementing selected negotiation strategies regarding specific arguments or issues (Goldman and Rojot 2003; Lewicki, Barry and Saunders 2010a). Tactics vary throughout the negotiation process. Based on these definitions and the taxonomy of negotiation styles, strategies, and tactics by Meyer and Schoop (2023), negotiation styles, strategies, and tactics are interconnected (cf. Figure 1). These interconnections are not distinct. Each style encompasses multiple strategies that can be applied; certain strategies are applicable to a variety of styles. For one strategy, multiple tactics can be employed; particular tactics can be applied across multiple strategies. These relations are illustrated in Fig. 1. Whilst a tactic constitutes a specific course of action within an applied strategy (more fine-grained), a style represents a general approach to negotiation that establishes the desired outcome and relationship. During the pre-negotiation phase, negotiators typically initiate the process by considering the desired outcome and relationship with their partner. Such preliminary consideration establishes the negotiator’s style as an orientation, thereby providing the foundation for subsequently defining a concrete plan. As part of the plan, the preferred application of strategies is then outlined. Negotiation styles, strategies, and tactics can be applied to negotiation. We define negotiation behaviour as an approach adopted by a negotiator to implement negotiation strategies and tactics for a specific style. This approach is influenced by several factors in the negotiation, including the negotiator’s own interest in the negotiation, their reciprocity to make concessions, the issues considered in the negotiation, and the power dynamics in the negotiation.

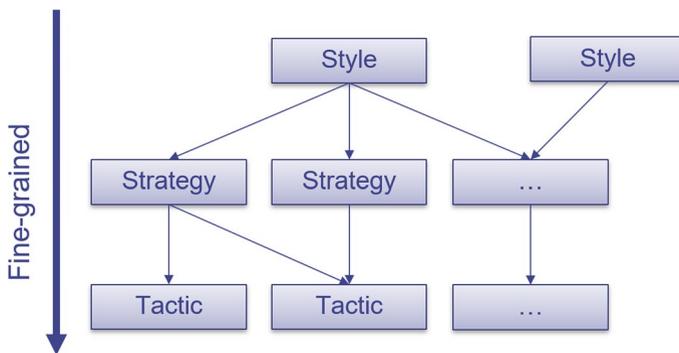


Fig. 1 Structure of negotiation behaviour

### 3 Methodological Approach

The methodological approach employed in our research follows the design science research (DSR) methodology established by Peffers et al. (2007) comprising six activities (cf. Figure 2).

The initial activity involves *identifying the problem* and establishing the motivation through the explicit articulation of the proposed artefact's significance. Previous research demonstrates that novices (later termed trainees) are unable to adequately identify the negotiation behaviour employed by their negotiation partner, particularly in a comprehensive manner (Meyer 2022). Previous research has developed various training systems, including tutoring systems with chat functionalities to personalise user experiences (Kerlyl et al. 2007), gamified feedback throughout all phases (Meyer et al. 2020), feedback concerning value creation and value claiming (Johnson 2021), negotiation outcomes (Dannenmann et al. 2022), negotiation performance (Core et al. 2006), learning experiences (Votintseva and Johnson 2024), empathy skill training (Sato et al. 2024), and feedback for self-reflection during post-negotiation phases (Meyer and Schoop 2024). What they fail to address is what we focus on in the current research, namely behaviour training for digital negotiations.

The second activity *defines the objectives*, i.e., how the proposed artefact will solve the identified problem. These objectives can encompass new solutions for an already existing artefact or a new artefact addressing the defined problem (Peffers et al. 2007). Effective negotiation requires proper training (Thompson 2022). Since literature does not reveal a dedicated approach for electronic negotiation behaviour training (including strategies, and tactics), our objectives involve designing a new artefact for trainees to learn to identify their partners' negotiation behaviour (including styles, strategies, and tactics). The negotiation partners are agents. Whilst there is previous research on negotiation agents, they predominantly focus on opponent modelling with the aim to outperform that opponent (Chen et al. 2022; Keskin et al. 2023; Khosravimehr and Nassiri-Mofakham 2017; Nazari et al. 2015; van Krimpen et al. 2013; Yu et al. 2013; Zafaria et al. 2014). The aim of outperforming trainees would not be aligned with the primary objectives of the training. Other agents solely mirror the behaviour of the trainee (Baarslag et al. 2013; Melzer et al. 2012), focus on integrative approaches such as the application of Social Exchange Theory (Chiou et al. 2019), or employ physical robots as negotiation partners (Mell et al. 2017). Thus, agents designed specifically for behaviour training remain scarce. Our research will contribute to closing that gap.

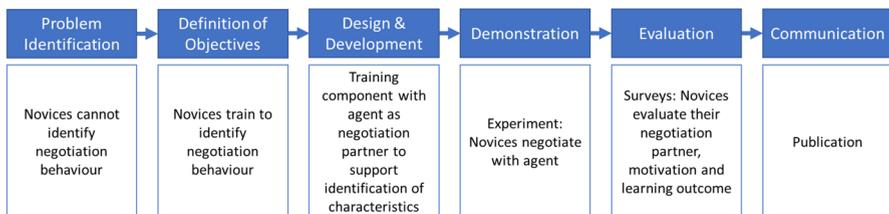


Fig. 2 Design science research approach

The third activity encompasses the actual *design and development* of the artefact. Artefacts can manifest as constructs, models, methods, instantiations, or technical features (Peffers et al. 2007). In our research, agents are designed and implemented to serve as negotiation partners (model). The agents employ various negotiation behaviour to enhance the trainees' awareness of such behavioural differences. The negotiation agents are designed to be domain-independent, enabling their application across multiple settings (Baarslag et al. 2016).

The fourth activity, namely *demonstration*, involves the testing of the implemented artefact. The aim of the demonstration is to establish the artefact to address one or more instances of the defined problem. This can be achieved through a variety of methods, including experiments, simulations, case studies, or formal proof (Peffers et al. 2007). In our study, trainees participated in negotiations with the implemented agents in international experiments and completed various surveys.

To validate whether trainees can identify negotiation behaviour, the artefact undergoes *evaluation* in the fifth activity. This evaluation examines "how well the artefact supports a solution to the problem" (Peffers et al. 2007, p. 56). Initially, a survey was completed by the trainees after each completed negotiation, with a set of structured response options, to ensure that trainees addressed questions for the appropriate agent. A subsequent survey employed the Intrinsic Motivation Inventory (IMI) to measure intrinsic motivation before and after training. Finally, a third survey determined the learning outcomes achieved through the training.

The sixth activity encompasses *communication*, i.e., publishing, the designed and evaluated artefact.

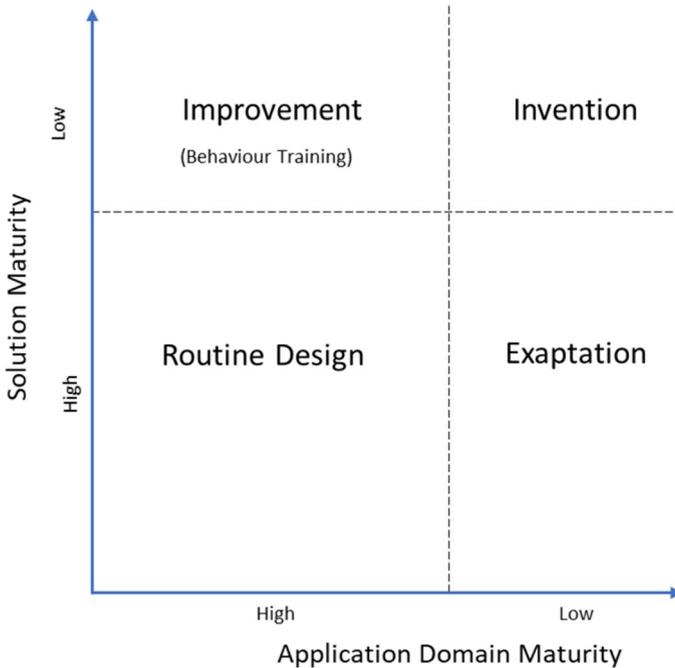
According to the maturity matrix developed by Gregor and Hevner (2013), each artefact can be classified according to the solution maturity and the application domain maturity. The solution maturity dimension characterises whether there are known solutions (high) or new solutions (low). The application maturity dimension characterises whether the problem is known (high) or new (low). Our artefact thus contributes to improvement (cf. Figure 3), as the problem is known (the necessity to train different negotiation styles, strategies, and tactics) and the solution is new (the artefact for behaviour training).

## 4 Electronic Behaviour Training—Design and Implementation

Following the outlined requirements, we designed agents with negotiation behaviour and implemented the artefact as part of the well-known NSS Negoisst (Schoop et al. 2003; Schoop 2021), whilst providing digital training.

### 4.1 Designed Agents

To assess how negotiation styles, strategies, and tactics in digital negotiations can be categorised, a taxonomy by Meyer and Schoop (2023) was used to derive negotiation behaviour. The Thomas-Kilmann-Conflict Mode Instrument (TKI) has been widely used to identify individual conflict styles (Thomas and Kilmann 1976, 2008); it can also provide insight into various negotiation styles (Meyer and Schoop 2023). The



**Fig. 3** Knowledge contribution framework of DSR (adapted from Gregor and Hevner (2013))

**Table 1** Expressions of behaviour parameter

Parameter	Expressions
Information exchange	Share information, withhold information, none
Strategy composition	Pure strategy, mixture of strategies, none
Time-dependency	Delayed, immediate, none
Behaviour-dependency	Concession reciprocity, none
Central concern	Partner, own, own & partner, none
Concession-making degree	Large, gradual, no, none
Concession-making approach	Random, trade-offs, fixed, none

categories of strategy and tactic, as introduced in the taxonomy, serve as parameters for the design of agents in the present paper (cf. Table 1). The expression “none” represents a parameter that remains unspecified.

*Information exchange* determines whether information is withheld or shared with the partner when sending an offer.

*Strategy composition* established how many different strategies and tactics the agent will employ. Pure strategy indicates that a single algorithm is utilised, whilst mixture of strategies encompasses multiple strategies and tactics being implemented.

To specify temporal changes in strategy or tactics (*time-dependency*), the progress of negotiations has to be established, e.g., through the number of offers sent. In our study, immediate concessions occur upon sending the initial message, whilst delayed concessions commence with the second (or subsequent) message.

*Behaviour-dependency* establishes whether the negotiator is willing to make concessions. When concession reciprocity is selected, the negotiator typically demonstrates their willingness to make concessions, particularly when their partner also makes concessions.

The *central concern* parameter determines the extent to which negotiators prioritise their own interests over those of their partner, categorised by target utility thresholds. The following target utility values were derived from empirical data obtained through comprehensive review of prior experiments and case studies with known negotiation styles of the participants. Those case studies exhibit integrative and distributive characteristics. When negotiators focus exclusively on their partner's outcomes, target utility ranges between 35% and 45%. When negotiators focus solely on their own interests, the target utility exceeds 70%. When negotiators balance both their partner's interests and their own interests, target utility falls between 45% and 70%. When negotiators are concerned with neither their own nor their partner's interests (as in the case of an avoiding style), no target utility is established.

The *concession-making degree* parameter is quantified through mathematical functions, gradients or delta utility values. Since the end of a negotiation is unpredictable, yet essential for the modelling of the applied algorithm (e.g., the number of messages sent or the utility achieved at the end of the negotiation), the mean number of messages sent from previous negotiations is used to predict the end of a negotiation. This is achieved by defining target utility as the point at which the mean number of messages has been exchanged. This does not imply that negotiations end upon reaching the message threshold; rather, concessions stagnate at this point. The subsequent values were derived from an empirical analysis which entailed the analysis of 1090 bilateral negotiations across a total of 17 experiments with Negoisst between 2016 and 2023. These experiments encompassed a diverse array of case studies, ranging from highly cooperative to more competitive cases, and from more to less complex cases with three to eight issues. No concessions signifies zero concession degree or where target utility equals current utility value of the negotiator. Gradual concession involves approx. 5% concession per offer or achieving target utility after ten offers. Large concessions entail approx. 10% concession degree per offer or reaching target utility after five offers. Whether predetermined concessions or the number of messages sent determines the decision-making degree depends upon the algorithm used for a certain behaviour.

As the *concession-making approach* characterises the expressions of the applied algorithms, algorithms matching specific traits are employed, e.g., a randomised algorithm is used for a random approach.

Various negotiation behaviour emerge through different combinations of selected expressions. Since some combinations of expression prove contradictory, the selection of feasible parameters and feasible negotiation behaviour is limited. We examined all feasible combinations of selected expressions and identified 53 potential negotiation behaviour types, which we subsequently termed combinations. These combinations

were mapped onto five meta-behaviour: *stalemate*, *tough*, *moderate*, *compromise*, and *soft*, as adapted from Vahidov et al. (2014). Expressions were allocated across meta-behaviour for agents functioning as negotiators: stalemate (3 combinations), tough (10 combinations), moderate (11 combinations), compromise (21 combinations), and soft (8 combinations). Figure 4 presents a comprehensive overview of all the specified negotiation behaviour expressions. The expression “n.s.” indicates categories for which no further specification is required for a particular behaviour. Some of these expressions can be selected for one meta-behaviour to define specific agents for implementation. These five meta-behaviour establish the basis for the different types of agents, which can be selected or randomly assigned for specific negotiations.

The derived behaviour for each meta-behaviour (stalemate, tough, moderate, compromise, and soft) illustrated in Fig. 4 facilitates a preselection of negotiators and enables allocation to particular negotiations. Furthermore, the selection of appropriate expressions (*Selected Expression*) is fundamental for the development of specific agents (*Agent's Behaviour*) as negotiation partners (cf. Figure 5). In order to establish a definition of the manner in which an agent will behave during a negotiation; it is necessary to select a particular expression of the agent's orientations which represents the agent's behaviour. The *agent's behaviour* is generally described by expressions of the parameters in Fig. 4, which determine how the agent behaves in negotiations. In order to behave in the described way, it is necessary to specify the applied algorithm

Behaviour category	Stalemate	Tough	Moderate	Compromise	Soft
Information exchange	Withhold Information	Withhold Information/ n.s.	Share Information/ n.s.	Share Information/ n.s.	Share Information/ n.s.
Strategy composition	Pure/ mixed	Mixed	Mixed	Mixed	Pure/ mixed
Time dependency	-	Delayed	Delayed	Delayed/ immediate	Immediate
Behaviour dependency	-	Concession reciprocity/ n.s.	Concession reciprocity/ n.s.	Concession reciprocity/ n.s.	Concession reciprocity/ n.s.
Central concern	Own	Own	Partner & own	Partner & own	Partner/ n.s.
Concession-making degree	No/ n.s.	Gradual/ n.s.	Gradual/ n.s.	Large/ gradual/ n.s.	Large
Concession-making approach	-	Random/ trade-offs/ n.s.	Random/ trade-offs/ fixed/ n.s.	Random/ trade-offs/ fixed/ n.s.	Random/ trade-offs/ fixed/ n.s.

Fig. 4 Agents' orientations

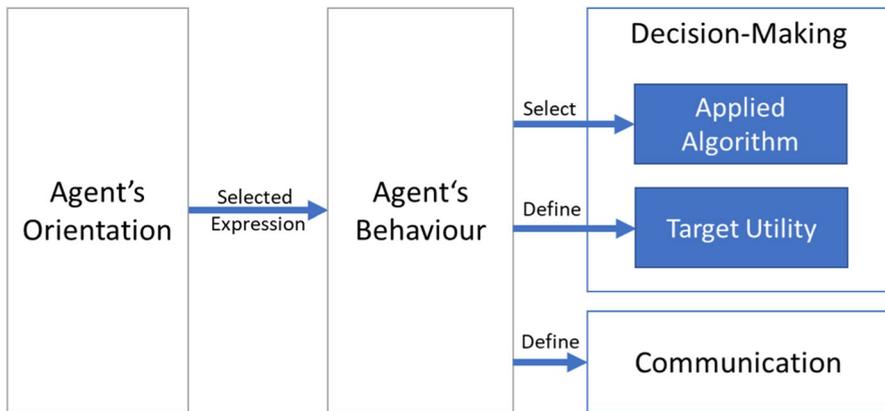


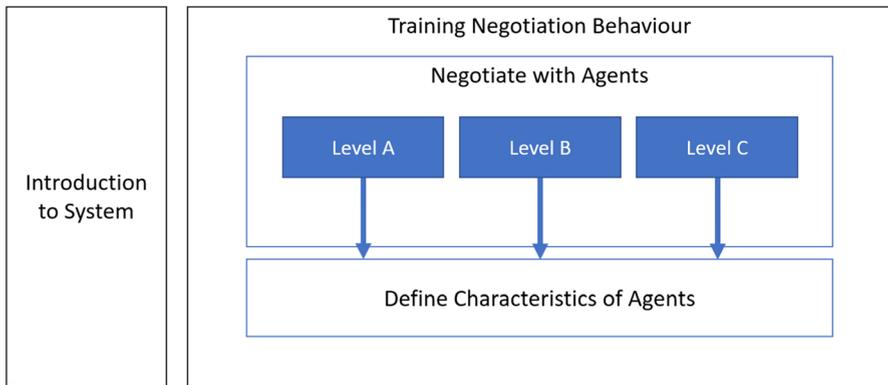
Fig. 5 Framework of agent

and the target utility in order to make decisions in negotiations. Additionally, the communication of such intentions to the partner should be accompanied by specific sentences. These specifications enable the agents to make and to communicate decisions. In order to conceptualise the decision-making process of agents, one has to specify the applied algorithm for modelling concessions and the target utility (as the reservation level). Based on the results of these 1090 negotiations (mean=10.1454; median=10 per bilateral negotiation), the number of messages to be sent by the agents is set to five for the purpose of this training (representing half the total message count). In order to exchange arguments, communication with the trainees is needed. The *information exchange* parameter defines how the agents behave when exchanging information through communication. Sentences which reflect agent behaviour require formulation. For example, a tough agent making delayed concessions begins with tough sentences, such as “We are currently unable to make any concessions...”.

### 4.2 Digital Training of Negotiation Behaviour

We designed a framework for behaviour training including the implementation of the designed agents. Figure 6 depicts the training, which comprises an introduction to the system alongside explicit behavioural training in three negotiations. Agents exhibit various behaviour as negotiation partners, requiring trainees to characterise each agent’s behaviour.

The following section provides a comprehensive overview of this training framework. Prior to the start of behaviour training, trainees receive an introduction to the NSS (shown as Introduction to System in Fig. 6). Subsequently, three levels (i.e., Level A: compromise; Level B: moderate; Level C: tough) with different behaviour are undertaken. Each level comprises a bilateral negotiation with varying negotiation partners, case studies, and complexity levels, which has to be successfully completed to advance to the next level. To ensure that trainees encounter diverse types of behaviour, they negotiate with agents designed according to Fig. 5. Following each level,



**Fig. 6** Framework training negotiation behaviour

trainees characterise the agents by describing the agent's behaviour (e.g., competitive with hidden information).

Considering the behaviour mentioned in Fig. 4, compromise (level A), moderate (level B), and tough (level C) behaviour were selected for training purposes. Negotiating with partners exhibiting stalemate (very distributive) or soft (very accommodating) behaviour is challenging for achieving precise argumentative exchange; such behaviour was, therefore, excluded from the training. Each behaviour comprises several combinations of human behaviour. These combinations demonstrate subtle variations in the expression of the behaviour. The most prevalent expression of each behaviour was selected and implemented as a uniform training partner (subsequently termed uniform opponent). The uniform opponent serves as a standardised negotiation partner for each level, thereby ensuring comparability and repeatability across all negotiations conducted at that level.

In accordance with the training framework, the behaviour of the agents must be specified. Table 2 presents the particular expressions of level A, level B, and level C. All three levels are characterised by a mixture of strategies.

As level A is defined as *compromise*, level A agents make immediate concessions. The agents are willing to make concessions whilst considering both parties' interests. These agents reveal information about themselves and their preferences to signal openness and interest in the relationship with their partner (*shared information*). Whilst the degree of concession-making remains unspecified, the approach employs fixed concessions through a conceder algorithm, with initially large concessions, tapering to smaller ones as the negotiation progresses (with *gradual concessions* on average). Consistent with the principle of immediate concessions, the opening offer includes compromises. The target utility is established at 60%, a reflection of the collaborative nature of the case study.

Level B (moderate) agents exhibit delayed concessions, withholding any compromises during the initial two messages before adopting a linear concession strategy from the third message onwards. These agents demonstrate reciprocal behaviour, making concessions when receiving concessions and balancing both parties' interests. As from the third message onwards, these agents share information regarding

**Table 2** Specification of Level A, B, C

	Level A	Level B	Level C
Behaviour category	Compromise	Moderate	Tough
Information exchange	Share Information (or n.s.)	Share Information (or n.s.)	Withhold Information (or n.s.)
Strategy composition	Mixture of strategies	Mixture of strategies	Mixture of strategies
Time dependent	Immediate	Delayed	Delayed
Behaviour dependent	Concession reciprocity	Concession reciprocity (or n.s.)	Concession reciprocity (or n.s.)
Central concern	Partner & own	Partner & own	Own
Concession-making degree	Gradual (or n.s.)	Gradual (or n.s.)	Gradual (or n.s.)
Concession-making approach	Fixed (or n.s.)	Fixed (or n.s.)	Random
Used algorithm	Conceder	Linear	Randomised
Target utility	60%	100%, then 65%	100%, then between 100 and 75%

themselves and, subsequently, their preferences. This characteristic is indicative of a more sceptical agent, who considers the interests of their partner during the course of the negotiation. The concession-making degree of these agents is gradual with a fixed approach. The target utility remains at 100% for the initial two messages, subsequently declining to 65%.

Level C (tough) agents similarly employ delayed concessions whilst prioritising self-interest exclusively. Nevertheless, they offer modest concessions in exchange for receiving concessions. The degree of concession-making is gradual, and the approach is random. The applied algorithms are the no concessions algorithm and the random algorithm. The absence of disclosure by these agents can be attributed to the contradictory and non-personal nature of the information provided (*withheld information*), which serves to indicate an absence of interest in the relationship. The target utility maintains 100% for the initial two offers and fluctuates randomly between 100% and 75% for the subsequent offers.

This study employs the IBM ILOG CPLEX Optimizer to execute offer calculations for designated expression characteristics of the agents. The IBM ILOG CPLEX Optimizer is a tool designed for the resolution of linear multi-objective problems (IBM). It determines optimal utility values within multi-attributive negotiations whilst accommodating constraints from established negotiation behaviour.

Regarding the communication aspects, sentences reflecting agents' behaviour are formulated and implemented through the Drools engine (Drools). Drools enables rule definition for specific negotiation behaviour and generates outputs as particular text phrases to justify offers provided and selected by the algorithms.

### 4.3 Applied System—Negoisst

The designed artefact has been implemented in the web-based NSS Negoisst (Schoop et al. 2003; Schoop 2021). Negoisst facilitates sophisticated digital negotiations, offering decision support, communication management, and comprehensive contract management. Throughout the past two decades, thousands of digital negotiations have been conducted via Negoisst globally. New features have been continuously integrated, encompassing various means of eliciting preferences, composing messages, rating offers, digital contracting, and digital conflict management (Schoop 2021).

Beyond bilateral human-to-human negotiations, Negoisst accommodates gamified training for bilateral human-to-machine negotiations. This training incorporates levels and leader boards to demonstrate progress in learning, whilst motivating and supporting participants (Schmid and Schoop 2022). Participants familiarise themselves with the system and develop negotiation skills through Negoisst by engaging with a tactical-negotiation-trainer (TNT). During the training, the TNT employs solely one behaviour, mirroring the participant's actions (namely tit-for-tat) (Melzer et al. 2012). Consequently, the TNT proves inadequate for training awareness to recognise the negotiation behaviour of the partner.

In addition to the human-agent negotiations that constitute the core of our negotiation training, participants can engage in human–human negotiations once they have completed negotiations with the agents. This enables them to adapt the content they have already learned to negotiations with human partners. Hence, our negotiation training incorporates a hybrid training approach.

## 5 Evaluation

Our negotiation training comprises three levels (A–C) that trainees have to complete. The purpose of the artefact is to enhance awareness of identifying negotiation behaviour in partners. This research contribution prioritises accurate behaviour identification, the Intrinsic Motivation Inventory (IMI) factor of the SDT, and the learning outcome for the trainees rather than negotiation success or failure.

### 5.1 Identification of Negotiation Behaviour

This section presents and analyses the findings regarding the identified behaviour. Two groups participated in the evaluation: group 1 (N=125; 60 females; 65 males; average age of 24.36 years) negotiating with a Tit-for-Tat agent, and group 2 (N=95; 52 females; 43 males; average age of 24.14 years) negotiating with the new agents, as shown in Table 2. Both groups participated in negotiations across the three levels and subsequently stated their partner's behaviour upon completion of each level. The participants engaged in negotiations involving various business cases, alternating between the roles of buyer and seller, with varying degrees of complexity and addressing three to eight issues.

The negotiations for group 1 were conducted during the training in 2023. The first conducted level for group 1 was concluded 131 times. Concession-making was recognised as a trade-off approach twice within the 131 negotiations conducted at level A. Level B was concluded 135 times. Tit-for-Tat was described twice amongst the 135 negotiations conducted at level B, though not explicitly stated. Trade-off as a concession-making approach and concession reciprocity were each identified once as the agents’ behaviour. The Tit-for-Tat behaviour was not explicitly stated in either level A or level B. Level C was completed 125 times. Among the 125 negotiations, only one participant was able to correctly label the agents’ behaviour as Tit-for-Tat. The agents’ behaviour was partially described as Tit-for-Tat eight times, with the concession-making approach being described as trade-off six times and as concession reciprocity twice.

Few trainees correctly identified Tit-for-Tat, while the majority reported divergent behaviour on the part of themselves and the agents. The agents were characterised as competitive in most cases, whereas the trainees’ own behaviour was described as compromising, collaborating or even accommodating. These findings indicate that Tit-for-Tat agents do not facilitate behavioural training, as mirroring behaviour requires the capacity to accurately identify one’s own behaviour and recognise its potential influence upon one’s partner’s behaviour.

For group 2, the agents deployed in our artefact varied by level; each level was examined separately (cf. Table 3). Furthermore, trainees were able to repeat levels; consequently resulting in a variation of the number of completed negotiations per level. The difficulty increased with each level. The trainees possessed subjective perceptions of what they deemed to be challenging, which led to the following consideration. The selection of *behaviour category* could be deemed correct in two ways: 1) trainees correctly identified the agents’ defined characteristic, and 2) if the trainees identified the agents’ behaviour category incorrectly, but they still correctly identified that the agents have become tougher in the course of the training.

As trainees were permitted to repeat levels at will, the number of behaviour identified varied for each level.

In total, 95 trainees identified behaviour 117 times in level A, with the central concern being correctly identified 76 times (64.96%). The strategy composition was correctly identified 77 times (65.81%). The concession-making degree was correctly

**Table 3** Correctly identified behaviour expressions of the agents

		Level A	Level B	Level C
Concluded Negotiations		117	119	127
Correctly identified	Central concern	76	36	104
	Strategy composition	77	72	72
	Concession-making degree	89	81	69
	Behaviour category 1)	36	19	69
	Behaviour category 2)	17	17	17
	Information exchange	96	83	81
	Total 1)	15	6	13
	Total 2)	19	2	3
	Total 1) and 2)	34	8	16

identified 89 times (76.07%). The behaviour category was correctly identified in 1) 36 times (30.77%) and in 2) an additional 17 times (14.53%). Information exchange was correctly identified 96 times (82.05%). All behaviour expressions were correctly identified in 1) 15 times, in 2) an additional 19 times, totalling 34 times (29.06%).

For level B, 95 trainees identified the behaviour 119 times. The central concern was correctly identified 36 times (30.25%). The strategy composition was correctly identified 72 times (60.50%). The concession-making degree was correctly identified 81 times (68.07%). The behaviour category was correctly identified in 1) 19 times (15.97%) and in 2) an additional 17 times (14.29%). Information exchange was correctly identified 83 times (69.75%). All behaviour expressions were correctly identified in 1) six times, in 2) additional two times, totalling eight times (6.72%).

For level C, 95 trainees identified the behaviour 127 times. The central concern was correctly identified 104 times (81.89%). The strategy composition was correctly identified 72 times (56.69%). The concession-making degree was correctly identified 69 times (54.33%). The behaviour category was correctly identified in 1) 69 times (54.33%) and in 2) an additional 17 times (13.39%). Information exchange was correctly identified 81 times (63.78%). All behaviour expressions were correctly identified in 1) 13 times, in 2) additional three times, totalling 16 times (12.6%).

The findings demonstrate that the agents assist trainees in identifying their partners' behaviour more precisely, particularly at level A, though this extends to other levels despite the varying complexity. The majority of trainees correctly identified strategy composition, concession-making degree, and information exchange across all levels. In level B, trainees misidentified the central concern, resulting in accurate behaviour recognition occurring on merely eight times across all behavioural expressions. Whilst the agents' communication lacked openness and clarity, it remained attentive to both parties, suggesting scope for enhancing training by making trainees more aware of such behaviour. The randomised concession-making approach at level C resulted in variations in strategy composition and concession-making degree, which led trainees towards divergent behavioural interpretations. Thus, behaviour was accurately identified across all expressions in a mere 16 negotiations.

The artefact, therefore, facilitates more nuanced identification of agents' negotiation behaviour than would otherwise be achievable. Having examined the training's impact on identifying agents' behaviour, attention must now turn to its effect on trainees' motivation.

## 5.2 Intrinsic Motivation

We adapted the IMI survey from the Center for Self-Determination Theory's website for digital negotiation training and administered it to the trainees of group 2 before and after completing the digital training. As this study does not examine internalisation studies or interpersonal interactions such as friendships, only the remaining five categories were assessed. Table 4 presents the findings, evaluated using a 7-point Likert scale (1 = totally disagree; 7 = totally agree). Given the modest sample size ( $N=95$ ), Huber's (1967) maximum likelihood estimators (MLE) were employed to reduce outliers and derive mean values. Before commencing the training, intrinsic motivation (MLE=4.51) and effort (MLE=5.73) could be measured. Subsequently, the remain-

**Table 4** Results IMI

	Before Training		After Training		Levene test for equal variance		t-test for equality of means
	Median	MLE (SD)	Median	MLE (SD)	F	p	p
Interest-Enjoyment	5.6	4.51 (1.261)	4.2	4.482 (1.465)	12.242	0.008	0.921
Effort	6	5.73 (1.000)	5.667	5.453 (1.164)	0.876	0.377	0.089
Perceived Competence	–	–	4.5	5.010 (1.180)	–	–	–
Pressure	–	–	4	3.578 (1.657)	–	–	–
Perceived Freedom of Choice	–	–	5.333	5.153 (1.199)	–	–	–

ing IMI factors were examined only after training completion. These results indicate that after the training, trainees were on mean intrinsically motivated (MLE=4.482), invested a considerable amount of effort into the training (MLE=5.453), perceived competence through the training (MLE=5.010), and perceived a sense of freedom of choice (MLE=5.153). Additionally, the participants reported a neutral to slightly disagreement regarding feelings of pressure during training (MLE=3.578).

In order to compare the trainees’ intrinsic motivation and effort before and after the training, ANOVA was conducted using independent sample t-tests. Levene’s test for equal variance demonstrated that there were no significant differences in terms of effort,  $F(1, 95)=0.876, p=0.377$ , but it revealed a significant difference in terms of interest-enjoyment,  $F(1, 95)=12.242, p=0.008$ . However, the two-sided significance tests for interest-enjoyment showed no significant difference ( $p=0.921$ ).

Thus, despite participating in sophisticated training involving multiple agents, the participants’ interest (intrinsic motivation) and effort remained stable throughout the training. Given that the digital training was mandatory and constituted a prerequisite for subsequent negotiations that were subject to grading, the digital training can be considered extrinsically motivated. The grading shifted the locus of causality from internal to external, thereby diminishing intrinsic motivation (Deci and Ryan 1985). This phenomenon is reflected in the minor changes to intrinsic motivation shown in Table 4. Moreover, trainees exhibited enhanced competence whilst reporting an absence of pressure on average. The increase in competence can be observed in two ways: 1) the identification of statistically significant variations in negotiation behaviour, as detailed in the previous section; and 2) trainees’ self-perceived competence gains. Furthermore, the following chapter provides a comprehensive analysis of the participants’ learning outcomes, thereby ensuring a thorough examination of the enhanced competence.

### 5.3 Learning Outcome

Following the completion of digital training by the trainees (N=95), participants of group 2 were asked to rank statements concerning their learning outcome using a 7-point Likert scale (1=totally disagree; 7=totally agree). The results of the

study are presented in Table 5. Consistent with previous analyses, we employed Huber's (1967) MLE to reduce the influence of outliers, and these were then utilised as mean values. Twenty-one questions were posed in order to validate outcomes, encompassing skill improvement, training satisfaction, and system knowledge categories. The skill improvement category is comprised of three distinct areas: general skill improvements, skill improvements in identifying partners' behaviour, and skill improvements to train the usage of one's own behaviour. The findings indicate that trainees have acquired system knowledge after participating in the training (MLE=5.442); and expressed satisfaction with the training relative to its intended purposes (MLE=4.953). Furthermore, the trainees exhibited general skill enhancement (MLE=5.197), including increased preparedness and adaptivity. Participants demonstrated enhanced negotiation skills through improved partner behaviour identification and management (MLE=4.431), while acquiring knowledge of diverse negotiation behaviour and their application in negotiations (MLE=4.702). In accordance with the challenges associated with intentionally employing behaviour and subsequently identifying the behaviour of the partner, mean values fell between slightly agreeable and neutral positions. Nevertheless, the findings indicate that the implemented training positively influences learning and identification of negotiation behaviour.

#### 5.4 Additional training information

In order to ascertain whether the component was sufficient, a subsequent investigation was conducted by dividing trainees of group 2 into two subgroups. Group 2.1 was provided with additional material on the various types of negotiation behaviour, strategies, and tactics (N=42), whilst group 2.2 received no supplementary information (N=53). Both subgroups were enrolled in a negotiation course and possessed fundamental negotiation knowledge.

The responses provided in section 5.1 underwent further analysis by categorising the results of each level according to the subgroups. Since trainees had the opportunity to repeat levels and behaviour identification exercises, the number of identified behaviour varied per level. The trainees identified central concern, strategy composition, concession-making degree, behaviour category, and information exchange through predetermined responses, each accompanied by brief explanations. For the purpose of subsequent testing, responses were coded numerically as follows: correct answers received a value of 1, incorrect answers received a value of 0. An independent sample t-test was conducted using ANOVA in order to compare the subgroups.

**Table 5** Results learning outcome

Category	Median	MLE (SD)
Skill improvement	General	5.143
	Identification of partner's behaviour	4.667
	Training own behaviour	5.000
Satisfaction training	5.000	4.953 (1.290)
System knowledge	5.500	5.442 (1.169)

**Table 6** Results Level A

Level A	Group 2.1	Group 2.2	Levene test for equal variance		t-test for equality of means
	(N=53)	(N=64)	F	p	p
	Mean (SEM)	Mean (SEM)			
Central concern	0.49 (0.069)	0.78 (0.052)	24.025	0.000	0.001
Strategy composition	0.64 (0.067)	0.67 (0.059)	0.457	0.500	0.733
Concession-making degree	0.75 (0.060)	0.77 (0.053)	0.074	0.786	0.892
Behaviour category	0.26 (0.061)	0.34 (0.060)	3.509	0.064	0.357
Information exchange	0.75 (0.060)	0.88 (0.042)	11.800	0.001	0.102

**Table 7** Results Level B

Level B	Group 2.1	Group 2.2	Levene test for equal variance		t-test for equality of means
	(N=56)	(N=63)	F	p	p
	Mean (SEM)	Mean (SEM)			
Central concern	0.34 (0.064)	0.27 (0.056)	2.603	0.109	0.415
Strategy composition	0.61 (0.066)	0.60 (0.062)	0.008	0.930	0.965
Concession-making degree	0.68 (0.063)	0.68 (0.059)	0.008	0.927	0.963
Behaviour category	0.14 (0.047)	0.17 (0.048)	0.887	0.348	0.640
Information exchange	0.70 (0.062)	0.70 (0.058)	0.002	0.963	0.981

The results of level A are shown in Table 6. The Levene’s test revealed no significant differences for strategy composition  $F(1, 53)=0.457, p=0.5$ , concession-making degree  $F(1, 53)=0.074, p=0.786$ , and behaviour category  $F(1, 53)=3.509, p=0.064$ . Two-sided significance tests for information exchange revealed no significant difference ( $p=0.102$ ). However, two-sided significance tests for central concern showed a significant difference ( $p=0.001$ ). The analysis of the mean value indicated that trainees without additional information performed better at identifying agents’ central concern (group 2.1 mean=0.49; group 2.2 mean=0.78).

Table 7 presents the results for level B. The Levene test indicated no significant differences for central concern,  $F(1, 56)=2.603, p=0.109$ , behaviour composition,  $F(1, 56)=0.008, p=0.930$ , concession-making degree,  $F(1, 56)=0.008, p=0.927$ , behaviour category  $F(1, 56)=0.887, p=0.348$ , and for information exchange  $F(1, 56)=0.002, p=0.963$ .

Table 8 presents the results for level C. The Levene test indicated no significant differences for central concern  $F(1, 63)=2.145, p=0.146$ , strategy composition  $F(1, 63)=2.107, p=0.149$ , concession-making degree  $F(1, 63)=0.026, p=0.873$ ,

**Table 8** Results Level C

Level C	Group 2.1	Group	Levene test		t-test for
	(N=63)	2.2	for equal		equality
		(N=64)	variance		of means
	Mean	Mean	F	p	p
	(SEM)	(SEM)			
Central concern	0.79 (0.051)	0.84 (0.046)	2.145	0.146	0.468
Strategy composition	0.60 (0.062)	0.53 (0.063)	2.107	0.149	0.417
Concession-making degree	0.54 (0.063)	0.55 (0.063)	0.026	0.873	0.936
Behaviour category	0.54 (0.063)	0.55 (0.063)	0.026	0.873	0.936
Information exchange	0.67 (0.060)	0.61 (0.061)	1.738	0.190	0.506

behaviour category  $F(1, 63)=0.026$ ,  $p=0.873$ , and for information exchange  $F(1, 63)=1.738$ ,  $p=0.190$ .

Apart from a significant discrepancy in the central concern of level A between group 2.1 and group 2.2, no further significant differences emerged across other behaviour expressions. The level A result may be attributable to trainees who presumed they had a comprehensive understanding of the meaning of the defined behavioural expressions' *own* concern (cf. Table 1) whilst adopting their own perspective rather than the agents' perspective, as specified in the survey. The assumption was incorrectly made that concerning *themselves* was defined as the agent's concerns regarding the partner rather than the agent's interests. Consequently, additional explanation is deemed unnecessary. The utilisation of pre-selected responses, accompanied by concise descriptions of agents' behaviour, has been demonstrated to be sufficient and may potentially reduce misinterpretation risks.

Across both levels A and B, the characteristic of behaviour category was predominantly misidentified by both groups. This phenomenon can be attributed to the utilisation of a largely subjective characteristic, namely the identification of agents as, e.g., compromise, moderate, or tough. An attempt was made to counteract this through providing explanations of behavioural expressions. However, trainees retained subjective perceptions of what they deemed challenging, with level difficulties being interdependent. Nevertheless, a learning effect between levels can be observed, as half of the trainees correctly identified the behavioural category in level C.

The modest proportion of trainees who accurately recognised the central concern in level B (group 2.1 mean=0.34; group 2.2 mean=0.27) stems from the agents' behaviour, which conveyed contradictory signals. Initially, these agents postponed the negotiation by discussing personal matters and justifying their reluctance to compromise. Subsequently, the approach shifted towards greater compromising and consideration of both interests. It appears that trainees retained their initial perception of the agents as predominantly self-interested. In order to ensure that trainees could observe the agents' strategic change, we verified each dataset's message count and exclusively included those demonstrating strategic change.

## 6 Concluding Discussion

Our designed artefact comprises two principal components: firstly, agents employing distinct negotiation behaviour whilst negotiating with trainees, and secondly, trainees evaluating these behaviour after the conclusion of negotiations. The agents serve as uniform opponents, thereby ensuring that external influences from training partners, such as fluctuating competence, mood, or time constraints, are minimised and do not affect the trainees. Moreover, the training framework enables trainees to determine autonomously when to complete particular levels, which aligns with IMI findings where trainees endorsed the perceived freedom of choice category ( $MLE=5.153$ ;  $SD=1.199$ ).

The enhanced competence demonstrated through improved identification of behavioural expressions, coupled with IMI results and learning outcomes, indicates that our designed artefact effectively supports negotiation behaviour training. Consequently, the artefact has proven successful in facilitating awareness regarding the adoption of negotiation behaviour, thereby fostering perspective-taking.

In the experiment, trainees exhibited superior accuracy in identifying behavioural expressions in comparison to their tit-for-tat training partners.

Upon completion of the survey on behavioural identification, the trainees received concise feedback on their responses. This feedback indicated whether the answers were correct or incorrect but did not specify what the solution was. This approach was selected for experimental evaluation purposes, as it enabled measurement of training effects amongst those who repeated levels. Nevertheless, in order to optimise learning outcomes, supplementary training incorporating more comprehensive feedback on the correctness or identified behavioural expressions is recommended.

Given the experimental nature of this study, which involved trainees from international universities pursuing programmes in Information Systems, Management, and Business Communication and Digital Media, the findings might reasonably be applicable for business negotiations in general.

This research contribution possesses certain limitations. Only three distinct behaviour were designed and implemented. In order to accommodate varying expertise levels amongst trainees, additional scenarios might be incorporated into subsequent levels. The trainees' individual TKI types, alongside the personal conflict types, were not considered, as the aim was to evaluate the designed digital training and the concept of different behaviour, as well as the mechanism for identifying these behaviour, rather than determining whether different TKI types influence behavioural identification accuracy. Nevertheless, this matter warrants further research. The trainees were extrinsically motivated to participate, as attendance was mandatory for the subsequent graded negotiation exercise. However, training performance itself was not formally assessed, since the mere act of participation was sufficient to ensure eligibility for the subsequent negotiation exercise. The learning outcomes remain subjective, as they are self-reported by participants. Given the relatively modest sample size of the experiment, further experiments could yield more comprehensive evaluations of the digital training.

As subsequent steps, the digital training could become more individualised by incorporating additional variables, such as TKI type, cultural background, and

expertise level of the trainee, or by expanding the component's functionalities (e.g., including additional behaviour or permitting trainees to determine which behaviour required training). In order to achieve this, the implementation of all meta-behaviour (including stalemate, soft, tough, moderate, and compromise) is recommended. Upon successful completion of level C, trainees should be permitted to select their partner by choosing one of the five meta-behaviour. The selection of an explicit expression of the meta-behaviour could then be made at random in order to vary the agents' negotiation behaviour. This would ensure greater variability in training scenarios.

Furthermore, to ensure more refined selection possibilities for administrators and advanced trainees, they could select behaviour expressions autonomously by generating their own negotiation partner, e.g., to prepare for a specific forthcoming business negotiation with particular negotiation partners. This capability would provide practitioners with tailored preparation opportunities that closely mirror real-world negotiation contexts.

The present study focused on the decision-making process of our agents. To this end, text modules were employed to visualise the behaviour expressions. In future research, it has to be investigated whether generative AI can be utilised in communication to construct messages in accordance with specific behavioural expressions and utility values. Such an approach has the potential to enhance the realism of the training environment by facilitating the generation of more contextually appropriate negotiation communications.

Our designed training can be employed to train novices to recognise different negotiation behaviour and to learn to identify those conducted by their negotiation partners in any type of business negotiation.

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## Declarations

**Competing Interests** The authors declare no competing interests.

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