Virtual Reality Negotiation Training Increases Negotiation Knowledge and Skill

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Abstract. In this paper we test the hypothesis that Virtual Reality (VR) negotiation training positively influences negotiation skill and knowledge. We discuss the design of the VR training. Then, we present the results of a between subject experiment (n=42) with three experimental conditions (control, training once, repeated training) investigating learning effects on subjects' negotiation skill and knowledge. In our case negotiation skill consists of negotiation outcome (final bid utility) and conversation skill (exploratory conversational choices in VR scenario), and negotiation knowledge is the subjects' quality of reflection upon filmed behavior of two negotiating actors. Our results confirm the hypothesis. We found significant effects of training on conversation skill and negotiation knowledge. We found a marginally significant effect of training on negotation outcome. As the effect of training on negotiation outcome was marginally significant and only present when controlling for overshadowing effects of the act of reflecting, we postulate that other learning approaches (e.g., instruction) are needed for trainees to use the information gained during the joint exploration phase of a negotiation for the construction of a bid. Our results are particularly important given the sparse availability of experimental studies that show learning effects of VR negotiation training, and gives additional support to those studies that do report possitive effects such as with the BiLAT system.

1 Introduction

Virtual Reality systems are effective tools to change human behavior in a wide variety of domains including training medical skils, education of children, military procedures, flying, but also the treatment of phobias through VR exposure therapy (see [22,29,19,26,28,2]). A key characteristic of these systems is that they are effective at inducing cognitive and behavioral changes for a relatively constrained and well-defined setting. Systems that have shown to be effective include treating particular anxieties through exposure of the subject such as fear of heights [8], training particular skills such as teaching children to safely cross

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a street [32], a particular procedure such as emergency situtation triage [1], or a particular sensory-motor skill such as a specific type of surgery [12]. More recently VR training has been proposed for ill-defined training tasks such as cultural understanding, persuasion, social skills and negotiation, usually in the form of a serious game [6,25,14,30]. However, for these more complex, and often ill-defined tasks, it is difficult to develop the right simulation content, storyline, interactions, and outcome measures [14]. As a result of these difficulties and the novelty of the field, there is only sparse evidence of such VR systems showing measureable learning effects, a point explicitly made in [30].

We focus on negotiation support systems for novice negotiators and within that context aimed to develop a VR negotiation training. Only several accounts exist of experimentally verified learning effects of VR negotiation training [20,7], and with the same system (i.e., BiLAT, [18]). It is therefore important to investigate learning effects targeted at the same phenomenon (i.e., negotiation knowledge and skills) with a different system, because positive results could easily be tied to the specific choices of a system with respect to domain, implementation, and content. In this paper we present an experiment with a virtual training system for negotiation that has been carefully constructed, involving a virtual agent that is able to express emotions and explain its behavior. VR negotiation training is in essence a role play between a human and a virtual human, as often used in traditional negotiation training. Therefore, the use of intelligent virtual agents equipped with human-like capabilities such as emotion and explanation is a logical choice. This paper addresses two topics. First it describes in detail the design of the system, so that choices and assumptions are made explicit. Second, we present results of an experiment investigating learning effects of the training on negotiation skill and knowledge. In our case negotiation skill consists of an outcome measure and a process measure; i.e., negotiation outcome and conversation skill. We define negotiation outcome as the utility of the final bid proposed by the subject. We define conversation skill as the number of times a subject selects responses that open the conversation towards finding underlying concerns minus the number of times a subject selects responses directing the conversation towards a premature ending. In our scenario, opening responses are responses that are polite, show interest in the other and ask for underlying interests instead of prematurely fix issues. We define negotiation knowledge as the subjects' quality of reflection upon the filmed behavior of two negotiating actors. Negotiation skill in our experiment thus measures in-game non-transferred skills as displayed in the actual negotiation behavior of subjects while playing the VR scenario. Negotiation knowledge measures implicit knowledge transferred from the VR training to the analysis of negotiation behavior of others.

In section 2 we provide background on negotiation and distill the requirements for our negotiation training. In section 3 we discuss the design of VR negotiation training in detail. In section 4 we present the experimental setup and results. Section 5 presents a more general discussion.

2 VR Training Requirements

The naive view on a negotiation is that it is a single task aimed at claiming the highest outcome value by bargaining the best price for a particular good. This naive view on negotiation has several important shortcomings resulting in a difficulty to reach a win-win outcome [10,27,31]. A win-win outcome is an agreed-upon bid that is optimal in terms of overall outcome value for both sides of the negotiation. First, the naive view focusses on a single issue, i.e., money, while any meaningful negotiation involves multiple issues, relationships, and emotions. Second, it focusses mainly on the bidding process and approaches bidding as bargaining (e.g., about price). This hinders getting a good overview of all issues that play a role in the negotiation and thus limits the possibility to place interesting bids that are good for both sides. Third, and related to the previous, it does not emphasize the different phases in a negotiation process. Any negotiation can be separated into at least four phases: preparation, joint exploration, bidding and closing (see, e.g., [15]). The preparation takes place before the negotiation partners meet, and involves the collection of information about one's own and the partner's desires. In the exploration phase, the negotiation partners start to explore each others' wishes. Subsequently, in the bidding phase the negotiation partners exchange actual bids, and in the closing phase the partners leave each other with or without an agreement, make plans for further negotiation, re-negotiation, and make sure the relationship is well-managed.

A more realistic view on negotiation is thus that it is a four step process involving the exploration of issue preferences of and by the different parties in the negotiation in order to be able to get closure on a deal that has value for all parties and will be respected afterwards. Although such a process seems overkill for simple day-to-day negotiations it is not [32]. Even the distribution of household tasks among couples is a multi-issue negotiation including issues such as doing the dishes, putting the kids to bed, cooking, and doing finances and taxes. Partners have preferences for or against doing these tasks and usually figure out a win-win bid that honors these preferences. These bids are renegotiable each day, and often *are* being renegotiated. The bids are complete bids (I don't feel like doing the dishes, but I don't mind putting the kids to bed, etc.) and not based on single issue bargaining. When getting home from work one usually has preferences about the different tasks and in fact privately prepares the negotation. Then in a short exploration phase the different issues and preferences are explored (I don't feel like doing X today, I don't mind Y, you don't mind X?, etc.). Several bids are exchanged, a deal is made and should be honored (no-one will get away in the long run with not honouring the fact that you said you would do the dishes but then simply decide not to). In fact these simple negotiations are perfect examples of negotiations in separate phases, and show the shortcomings of the naive view on negotiation: you rarely bargain about a single household issue and then think it is fair to claim as much value (as little work) as possible.

The example also highlights the importance of ensuring a good relationship. Most negotiations involve a relation between the two negotiation partners. Even

after buying a car a relationship follows, albeit a very limited one (service agreement). This brings us to an important element in negotiation: emotion. Emotions play a role before, during and after a negotiation. People have preferences about issues that are in essence affective attitudes. People have an opinion about negotiation in general and about having to enter one in particular. People experience emotions during negotiations, and use emotions strategically. As such, it is critical to address and be aware of your own and the other side's emotions in a negotiation [9], and the importance of emotion in negotiation has been experimentally shown in a large number of psychological studies (for review [4]).

An often-made mistake by novice negotiators in the joint exploration phase is to only explore each others' preferences on issues, e.g. the height of a salary, and forget to ask about the other's interests, e.g. the need of enough money to pay the mortgage. It is important to learn that by exploring someone's interests, alternative solutions can be found that are profitable for both partners, e.g. a lower monthly salary but with a yearly bonus. This mistake was confirmed by a diary study we performed as a preparation for the development of the virtual reality scenario. The study involved 8 subjects who were asked to keep track of their negotiation for a new job or a new house. Subjects often reported about issues, but rarely reported how these issues were derived from one's own underlying interests, let alone the interests of the other party.

These case studies and theoretical analysis have been the basis for the requirements of our negotiation training. First, trainees must follow a phase-based negotiation, with a clear separation between exploration and bidding. Second, emotions play an important role during the negotiation training. Third, the training should focus on investigating underlying concerns, rather than issues.

3 VR Training Design

The main training goal is to make people realize the importance of, and get skilled at, investigating issues and interests (underlying concerns). The training involves a negotiation about terms of employment and involves a human player in the role of an employer and a virtual agent playing the future employee. It has two negotiation phases: the joint exploration phase and the bidding phase. The trainee can interact with the agent by selecting a conversational response from a multiple choice selection (Figure 1). Choices influence the course of the scenario as explained below. The scenario is represented as a conversation tree with branches that can be conditionally activated or deactivated based on previous choices. Total playtime averages around 10 minutes, and the tree consists of about 150 sentence nodes. The virtual agent communicates in natural speech, pre-recorded by a professional voice actor. Beforehand, the virtual training and scenario were reviewed and approved by a professional negotiator.

In more detail, the training scenario focuses on the exploration phase in which the trainee and the character explore each others' standpoints concerning topics such as monetary gain and commute time. A total of four topics are explored in a fixed sequence. Throughout the scenario the trainee can make subtle conversational choices approaching the topic either from an underlying interest point

Fig. 1. The negotiation training showing two conversational options, the Virtual Character and the explanation as a thought bubble (left). Emotional expressions (right).

of view or an issue point of view. Conversational choices that approach the topic based on underlying interests will eventually broaden the range of issues that can be used to resolve a conflict. The mechanism is the same for all four topics. Interest-based exploration will trigger the Virtual Character (VC) to introduce a non-distributive issue to resolve a conflict around a distributive issue for a particular topic. Values for a distributive issue are positively related to the utility for one negotiator but negatively to the utility for the other (if one wins, the other looses), while values of a non-distributive issue have the same relation to the utility of both negotiators (both win or loose together). For example, if the trainee keeps asking about why the virtual character (the future employee) needs a particular salary, eventually the VC will tell the trainee that he is planning a world trip in one year (interest) and needs to have a certain amount of money for this, but that it is also possible to get this money as an end-of-year presentation-based bonus instead of a fixed salary. This should be acceptable to the trainee as this limits the financial risk of hiring personnel and gives incentive to the employee to work hard (the trainee is told in the role description that he/she owns a startup and hence risk and motivated personnel is an important thing to manage). The end-of-year bonus is a non-distributive issue that can be used to replace the distributive issue salary. All interests and issues used in the scenario are based on the diary studies.

When all four topics in the exploration phases have been explored, the trainee constructs one complete bid based on the issues that have been found during the exploration phase. This bid typically consists of distributive and non-distrubutive issues as found through conversation with the VC. For each topic the trainee has three options, two are always available, the third has to be 'unlocked' by exploring the agent's interests in the exploration phase as explained above.

The first option is the value for the distributive issue according to the trainee's original standpoint (hardliner). The second option is a compromise value for that issue, in between the trainee's and VC's standpoint. The third option is a win-win value for the non-distributive issue. The utility of the bid is scored as follows. For each non-distributive issue used in the bid the utility gain equals 2. For each compromise on a distributive issue the utility gain equals 1. For each hardliner value, the utility gain equals 0. This means that the utility ranges between 0 and 8 (4 topics in total). A win-win agreement is defined as a utility>6, no agreement is defined as a utility<3. Other values involve compromise agreements. As a result, only subsequent finding and use of the non-distributive issue in constructing the bid can lead to a win-win solution with a high utility, reflecting the fact that the bid must be good for both parties.

To enhance the realism of the virtual training, and to emphasize the importance of emotions during the negotiation process, the VC facially expresses three basic emotions as feedback to the trainee's selected response option: happiness, sadness and anger. These expressions have been evaluated beforehand in a separate study (n=19) and showed to be uniquely identifiable [5]. These three emotions have been chosen because of their meaning for giving feedback to a conversation partner. Happiness signals a - for the virtual character - potentially positive outcome of a chosen option (i.e., happyness is the VC's reaction to a trainees selection of a response that opens up the conversation towards underlying concerns), sadness signals a potentially bad outcome (i.e., expressed when the trainee selects a response that steers away from underlying concerns), while anger signals an actual bad outcome (i.e., a reaction to the trainee selecting a response that eliminates the possibility to use a non-distributive issue in the final bid). This meaning is compatible with a goal-based intrerpretation of emotions as in cognitive appraisal theory [24], as well as operant conditioning where positive (social) feedback is given to reinforce behavior and negative (social) feedback is given to discourage behavior.

Because understanding of the other side's preferences is an important shortcoming of novice negotiators (see above), we support trainees in their learning by making the negotiation agent (the VC) able to explain its own behavior. Explanations about agent behavior aim to help trainees to better understand played training sessions and learn from them, see e.g. [16,33,11]. The explanations in this system are based on our previous work on the development of explainable BDI agents for virtual training [13]. The approach is based on folk psychology, i.e. the way people think that they think. Namely, humans explain and understand their own and others' behavior in terms of its underlying desires, goals, beliefs, intentions and the like [17,21]. In earlier work, we explored which explanation types people prefer in which situation (e.g. belief or goal-based explanations) [3], and proposed guidelines for the explanation of agent behavior [13]. These guidelines have been used to develop the explanations for the training. The explanations are offered in the form of thought clouds (see Figure 1) to offer explanations at the time they are most relevant, but without disturbing the flow of the scenario.

4 Experiment

To evaluate training effects of the negotiation training, we have conducted an experiment. Our main hypothesis was that VR negotiation training improves negotiation knowledge and skills. We now detail the experimental design, protocol, subject sample and materials.

4.1 Method

We performed a standard between-subject experiment with three conditions. In the *control* condition subjects did not perform a VR training session prior to collecting effect measures. In the *single* session condition subjects performed one VR training session. In the *repeated* condition subjects performed 5 sessions. As preliminary studies with smaller number of subjects and only a single training session did not show learning effects, the repeated condition was added to make sure subjects had enough training. One training session took approximately 10 minutes. Table 2 shows the experimental protocol schematically.

First, all subjects rated their daily life self-reported negotiation skill, negotiation liking, negotiation frequency, and negotiation perseverance when negotiating. Ratings were on a 5-point Likert scale. As Cronbach's alpha for the four items was acceptable (alpha=0.71), the four items were integrated into one construct measuring self-reported *negotiation tendency*. This tendency to negotiate thus consists of self-reported doing, liking, skill and perseverance in negotiation.

Second, the subjects in the single session and repeated conditions performed the VR negotiation training with explanations and emotions in an office setting behind a standard desktop pc wearing headphones. Subjects in the single session condition were asked to play as well as possible. Subjects in the repeated condition were asked to explore the training in the first four sessions but to play as well as possible in the 5th session. We recorded final negotation outcome and conversation skill for both conditions. Subjects in the control condition did nothing but continued immediately with the next step in the protocol.

Third, we presented each subject with 5 pre-recorded scenes showing a similar job negotiation acted by two actors. Beforehand, the scenes had been judged plausible by a professional negotiator. We asked subjects to take the role of advisor for the employer and write a reflection upon these scenes in an open response format. Subjects were asked to answer two questions per scene: What just happened in the scene? And, what is your advice for the employer? After the experiment two independent raters rated the quality of the reflection for each subject based on the following coding scheme that identifies knowledge and understanding of negotiation:

- The advisor proposes to ask for the underlying reason for the employee's preference for part-time work (scene 1).
- In case of an impasse, the advisor proposes to broaden the negotiation by explicitly mentioning new issues or interests (scene 2, 3).
- The advisor proposes a clear closure of the negotiation (scene 4).

- The advisor assumes negotiation partners are equal: there are no signs of hierarchy, single-sided dependency, dominance or a 'battle for points'.
- The advisor stresses the importance of a good atmosphere.

For each item 1 point could be gained, effectively creating a 6 point scale (1-6). As the inter-rater reliability between the two raters was excellent (Cronbach's alpha=0.91) we combined the independent ratings, resulting in one rating per subject. This rating of reflection quality is our measure of *negotiation knowledge*.

Finally, all subjects performed a test in which they played the VR negotiation scenario again. We recorded negotiation outcome and conversation skill. Subjects were again asked to play as well as possible.[1]

Subjects (mean age=24.7, std=4.5) were recruited of two different universities, and were gender balanced accross conditions, resulting in 7 males and 7 females in each condition totalling 42 subjects, 14 in each condition. Assigment to the conditions was random. The conditions did not differ significantly in age (ANOVA $F(2, 39)=2.241$, $p=0.120$), nor in self-reported negotiation tendency (ANOVA $F(2, 39)=1.585$, $p=0.218$).

4.2 Main Results

To investigate if VR training increases negotiation skill and knowledge, we performed a multivariate ANOVA with training condition as independent variable and test conversation skill, test negotiation outcome and negotiation knowledge as outcome measures.[2]. We found a significant effect of training (Wilks' Lambda $F(6, 74)=2.668$, $p=0.021$). In detail we found a significant effect on negotiation knowledge ($F(2, 39)=4.315$, $p=0.020$) and conversation skill ($F(2, 39)=3.668$, $p=0.035$), but not on negotiation outcome ($F(2, 39)=0.593$, p=ns). Contrasts (LSD method) showed that lack of training results in a significantly lower rating for negotiation knowledge (mean=2.39, std=1.11) than a single session (mean=3.5, std=1.14, $p=0.011$) or repeated sessions (mean=3.39, std=1.04, $p=0.021$), and that lack of training results in a significantly lower (mean=-0.93, std=4.46) conversation skill than repeated training (mean=4.71, std=5.74, $p=0.01$). None of the contrasts between the three conditions were significant or even approached significance for negotiation outcome (all $p>0.32$). Conversation skill after a single training did not significantly differ from either no training or repeated training (mean=2.43, std=6.27, $p=0.12$ and $p=0.28$ respectively). This confirms our hypothesis. Training has a positive influence on negotiation knowledge and conversation skill. Apparently more training is needed for gaining skill,

[1] Emotional facial expression and explanations were omitted, as we will use this test as baseline performance in future experiments aimed at testing the influence of emotion and explanation as separate factors. A second reason to omit these is that they are informative means of feedback aimed at learning, while we wanted to use this as a test.

[2] Gender effects were non-significant in a MANOVA with condition and gender as independent variables (Wilks's Lambda $F(6, 68)=2.438$, $p=0.081$), and no interaction effect between gender and training was found.

Control:	Self-reported negotiation tendency	-	Reflection	Test
Single:		Training 1x		
Repeated:		Training 5x		

Negotiation outcome	Utility of the constructed bid	Obtained from bid constructed in the 1st Training (single condition), the 5th Training (repeated condition) and the Test (all conditions).
Conversation skill	Subject's responses that open, minus those that close the conversation, i.e.: *skill=#happy - #sad - #angry*	Obtained during exploration phase in the 1st Training (single condition), the 5th Training (repeated condition) and the Test (all conditions).
Negotiation knowledge	Rating of quality of written reflection on acted negotiation scenario	Obtained during the reflection upon filmed negotiation scenes

Fig. 2. Experimental conditions and protocol (top); dependent variables (our outcome measures; bottom).

but a single session of about 10 minutes is enough for gaining implicit knowledge as measured by the quality of reflection on filmed scenes.

As reflecting upon scenes could overshadow the effect of training on negotiation outcome, we performed a simple ANOVA with single versus repeated training as independent variable and negotiation outcome taken from the single training session and the 5th repeated session *before the reflections* as outcome measure. The effect of single versus repeated training approached significance ($F(1, 26)=4.002$, $p=0.056$) with higher negotiation outcome for repeated training (mean=4.21, std=1.31) compared to a single session (mean=3.29, std=1.13). To analyse the main effect of reflection, we performed a within-subject multivariate repeated measures ANOVA with reflection as independent variable and conversation skill and negotiation outcome as dependents. We found a marginally significant effect of reflection ($F(2, 26)=2.807$, $p=0.079$), that was significant only for conversation skill ($F(1, 27)=5.480$, $p=0.027$) with pre-reflection conversation skill being lower (mean=0.32, std=7.09) than post-reflection negotiaton skill (mean=3.57, std=6.02).

4.3 Addional Analyses

In this section we highlight several trends and findings that are not directly related to our main hypothesis, but are relevant for negotiation training.

Gender Effects. Gender effects approached significance for negotiation knowledge ($F(1, 36)=3.55$, $p=0.068$) and conversation skill ($F(1, 36)=4.03$, $p=0.052$). Female participants had lower negotiation knowledge ratings (mean=2.79,

std=1.20) than males (mean=3.40, std=1.11) and they had lower post-reflection conversation skill ratings (mean=0.81, std=4.61) than males (mean=3.76, std=6.63). We found a significant effect of gender on self-reported negotiation tendency ($F(1, 40)=11.380$, $p<0.01$), with female participants reporting a lower tendency (mean=2.21, std=0.57) than males (mean=2.90, std=0.74). We did not find significant difference between male and female participants when it comes to negotiation outcome, neither pre-or post reflection.

Conversation-Outcome Relation We found pre- and post-reflection conversation skill to correlate with pre- and post-reflection negotiation outcome ($r=0.832$, $p<0.01$; $r=0.688$, $p<0.01$; respectively). This indicates that subjects with a high conversation skill are also good at reaching a high outcome, which is interesting for two reasons: (a) it shows that the training is coherent (better exploration = better bidding), and (b) increasing conversation skill through VR training is a useful goal, as the two are linked.

We found a significant correlation between self-reported negotiation tendency and pre- and post-reflection conversation skill ($r=0.412$, $p=0.029$; $r=0.329$, $p=0.033$; respectively), and marginally significant correlations between self-reported negotiation tendency and pre- and post negotiation outcome ($r=0.348$, $p=0.069$; $r=0.280$, $p=0.073$; respectively). We interpret these findings as indicating that the tendency to negotiate is an indicator of actual negotiation skill.

5 Discussion and Conclusion

Our main results confirm our hypothesis that VR training has a positive effect on negotiation conversation skill and negotiation knowledge. Further, reflecting upon filmed scenes has a positive effect on conversation skill in the VR training. Our results support recent findings of others showing positive learning effects of VR training [20,7]. To assess if developing a VR training is worth the effort, future work should investigate differences between VR training and traditional training methods such as paper-based materials and role playing. Our results also show that there is (a) transfer from the training to the quality of reflections on a negotiation of others, and (b) transfer from reflection to conversation skill in the VR training. This highlights the importance of controlling for outcome measurement effects as measurement itself can overshadow or interact with the actual manipulation, a point stressed by our finding that *before* reflection the effect of single vs repeated training approached significance but not *after* reflection.

Our results show that *although* VR training increases conversation skills and knowledge, it did not automatically result in a better negotiation outcome, *even though* there is a strong correlation between individual ratings of conversation skill and outcome. We interpret this as follows: good negotiators already understand the link between exploration and bidding, while those that do not understand this link can get knowledge and conversation skills out of VR training but need additional forms of teaching (e.g., explicit instruction or negotiation rules) in order to understand the link. This lack of a learning effect is consistent with work described in the negotiation training literature [23] concluding

that pure experience-based learning is largely ineffective. Our results nuance this conclusion slightly by supporting the following view: although experience-based learning does not positively influence the joint outcome, experience-based learning does positively influence negotiation knowledge and conversation skills. We hypothesize that the reason for the lack of a positive effect on the actual joint outcome of the negotiation is due to participants' inability to bridge the gap between exploring the negotiation space and translating the results of the exploration into a concrete bid. Future work should investigate if different negotiation phases need different learning approaches.

We did not observe a clear effect of gender when it comes to negotiation outcome, conversation skills and knowledge related to VR training and reflection. However, lower self-reported negotiation tendency for women does indicate that further study towards gender differences in negotiation training should be done, especially since our results seem to indicate that this tendency to negotiate is related to negotiation skill in the VR training.

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