

# Impact of Virtual Agents' Behaviour on Obedience and Social Norm Compliance

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**Abstract**—Interpersonal attitudes significantly influence social interactions and have been shown to affect human behaviour around embodied digital agents. This study examines how social agents' interpersonal attitudes impact people's willingness to obey and adhere to social norms, with a particular focus on enhancing the perceived submissiveness of submissive agents. Participants were instructed to gather a coffee cup and could choose to walk either behind or between two agents in experiments conducted using virtual reality and video-based scenarios. The results revealed that participants tended to breach social norms by walking through the agents' "o-space" when the agents did not interact with them. Additionally, participants showed a greater tendency to walk around the agents in video-based scenarios compared to the VR environment.

**Keywords**—virtual reality, social agents, interpersonal attitude, interactional space, social norms.

## 1. Introduction

With advancements in media technology, interactions between humans and digital characters (often referred to as social agents) are increasingly common [1]. Research in this area often focuses on creating realistic virtual characters [2]. As part of this effort, it is important to understand how interpersonal attitudes can be conveyed by social agents and how these attitudes affect people's behavior around them. Argyle identified dominance and friendliness as key factors in assessing interpersonal attitudes [3]. Building on this

framework, Pascoe conducted experiments to examine how interpersonal attitudes of agents affect people's behaviour around them [1]. Our experiment extends Pascoe's research, using the same interpersonal attitudes as behavioral conditions for social agents. Friendly-Submissive, Friendly-Dominant, Hostile-Dominant, Hostile-Submissive, Neutral Non-Verbal, and Control [1]. To address the issues in Pascoe's study, where submissive conditions were not perceived as intended, we refined these conditions using insights from relevant research. Participants will be tasked with retrieving a coffee cup. During interactions with two virtual agents, they will decide whether to comply with the agents' requests to wait (obedience) and whether to enter their o-space or walk around them (social norm adherence). To extend Pascoe's study, we incorporated video testing alongside VR.

### 1.1. Research Question

This study will seek to answer the following research question and its further sub-questions based on Pascoe's (2024, p. 4) study:

*What impact does the perceived interpersonal attitude, in terms of friendliness and dominance, of a dyad of social agents have on the behavior and obedience of the proxemic users in virtual reality?*

## 1.2. Research Subquestions

The research question has been further divided into the following subquestions:

RQ1: *“How does the perceived interpersonal attitude of the agents influence the user’s movement patterns, choosing either to walk around the group or through its o-space?”*

During each test, we will track the participants’ paths to determine whether they break social norms by walking through the space between the agents (o-space), or adhere to the norms by walking around them.

RQ2: *“How does the perceived interpersonal attitude of the agents affect the amount of time a user waits after being given a verbal command to do so by the agents?”*

To assess the participant’s obedience, we will use the time taken to complete the task as a proxy for how long they waited.

RQ3: *“What effect does the perceived interpersonal attitude of the agents have on users’ valance towards the agents?”*

After each trial, participants will answer two 7-point Likert scale questions and evaluate the agents’ interpersonal attitude on a circumplex model.

RQ4: *“How can the perceived submissiveness of agents be improved?”*

We aimed to improve the perceived submissiveness of the Friendly-Submissive and Hostile-Submissive conditions by modifying the agents’ verbal cues based on relevant studies.

## 1.3. Hypothesis

We anticipate that participants will exhibit some level of obedience to the agents’ commands. Additionally, based on Pascoe’s findings [1], we expect that agents displaying friendly behaviour will be more likable, leading participants to adhere more to social norms in their presence. We also predict lower adherence to social norms and reduced obedience in the video-based experi-

ments compared to VR, given that we expect video-scenarios to feel less real.

## 2. Background

Regarding the applicability of interpersonal attitudes in human-computer interaction involving virtual agents, some studies, e.g. Geiskkovitch et al. [4], Patel and MacDorman [5], reveal that people’s obedience is influenced by an agent’s behaviour and its interpersonal attitude. The emotional expressions of virtual characters, such as facial expressions, gestures, and speech, are a key component of conveying this interpersonal attitude. These cues can influence people’s emotional states, decisions, and social interactions. For example, Vinayagamoorthy et al. emphasized the importance of building expression into virtual characters [2], showing that such expressions significantly affect users’ engagement and emotional responses in virtual environments.

Regarding the interaction with virtual agents attention should also be given to spatial relationships and social norm adherence. “O-space,” a concept from Interactional Spaces theory by Kendon [6], refers to the invisible, shared space that forms between two or more individuals during face-to-face interactions. This space, typically an open area between participants, serves as a “focus area” for exchanging eye contact, gestures, and speech, facilitating social exchanges. In most cultures, it is considered a social norm to avoid entering the o-space of a dyad or a group engaged in interaction.

Pascoe’s research provides valuable insights into how the interpersonal attitudes of virtual agents, categorized along dimensions of friendliness and dominance, affect user behavior in VR [1]. This study investigated scenarios where participants needed to navigate around a dyad of agents, analyzing whether their decisions adhered to social norms, such as avoiding the o-space. The study - in line with the previous study of Zojaji - found that agents perceived as friendly

elicited higher levels of compliance with social norms [7].

### 3. Method

This section details the design, implementation, and analysis of the pilot studies and the main study, including the technologies employed and the research methodology guiding the experiments.

#### 3.1. Participants

Fourteen participants were recruited in Sweden, with six participating in the video-based experiments and eight in the VR experiments. Participants received snacks after the study but no other compensation. Similarly to Pascoe’s study, the sole requirement for participation was fluency in English and being over 18-years-old [1].

#### 3.2. Digital scenario

The experimental scenarios mirrored those used by Pascoe. The setting was an office space with a table, sofa, and two embodied agents from the Greta platform standing on opposite sides of a table, which held a coffee cup [1]. The table layout ensured agents were closer to the table than to each other, and participants stood approximately 2.75 meters away at the beginning of the starting point [1]. During each trial, one agent, randomly chosen, used CereProc-generated speech to communicate with participants, excluding the Control and the Neutra-Non-Verbal conditions. The agent’s interpersonal attitudes included Friendly-Submissive, Friendly-Dominant, Hostile-Submissive, Hostile-Dominant, Neutral-Non-Verbal, and Control(see table 1). Participants were tasked to fetch the coffee cup from the table behind the agents and then return to the starting point.

**3.2.1. Altering the Submissive Condition.** One of our main goals with this study was

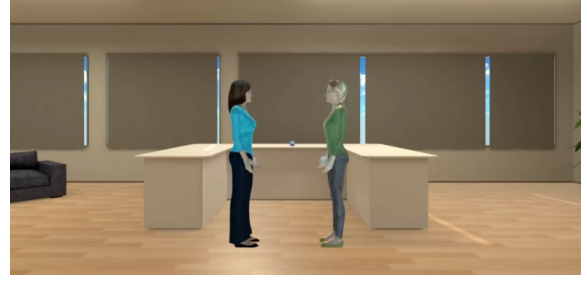


Figure1: scene example

to enhance the perceived submissiveness of the agents used in Pascoe’s study. Therefore, we tried to emphasize submissive behaviour in the agents, such as conflict avoidance [8], conveyed by overly apologetic phrases, hesitation and longer, less strictly structured sentences to suggest their frustration in the social scenario presented [9].

No.	Code	Intended Attitude	Non-verbal Behaviour	Dialogue
1	FD	Friendly / Dominant	Smiling face, warm vocal tone, wide arm gesture, Body Orientation and Gaze	"Thank you for waiting, we just need to finish up"
2	FS	Friendly / Submissive	Smiling face, Warm vocal tone, Body Orientation and Gaze	"I'm really sorry , but could you give us just a minute please, if you don't mind?"
3	HD	Hostile / Dominant	Angry face, Aggressive vocal tone, Wide arm gesture, Body Orientation and Gaze	"Do not interrupt us, you have to wait!"
4	HS	Hostile / Submissive	Angry face, Aggressive vocal tone, Body Orientation and Gaze	"Excuse me, emm I'm sorry, you can see that we haven't finished here. Would you mind waiting a bit longer please?"
5	NNV	Neutral Non-Verbal	Body Orientation and Gaze Only	None
6	CON	Control	Still	None

Table 1: Summary of experimental conditions with their related interpersonal attitude and behaviours

#### 3.3. Software and equipment

For the VR experiments, we used a Meta Quest 2 headset and an HP Pavilion computer. The VR environment ran on Unity 2021 with SteamVR and was streamed to the headset via Air Link over Wi-Fi. The

Greta platform was utilized to create agents capable of generating verbal and non-verbal behaviors with emotional layers. CereProc software enabled text-to-speech functionality. Video experiments were conducted using a MacBook and a smartphone for timing.

### 3.4. Research Design

Similarly to Pascoe's [1], a within-subjects design was employed to eliminate the effect of individual differences. Participants viewed scenarios under six conditions, each presented once. We decided to present each scenario once, as participants in Pascoe's study – where the conditions were presented three times – reported significant fatigue [1].

Pilot studies—two for video and five for VR—were conducted to ensure procedural robustness, identify technical issues, and to align experimental setups with research objectives. All pilot study participants were research team members.

### 3.5. Process

The experiment was introduced to participants as focusing on social agents in virtual environments but without revealing details about what is being measured. After signing consent forms, they completed a Google Form collecting demographic data. Gender matching between participants and agents was used to mitigate gender effects [1] [7]. Participants were then provided scenario and task instructions.

**3.5.1. VR.** Participants, equipped with a Meta Quest 2 headset, familiarized themselves with the virtual environment before beginning. The experiment included two demo trials using neutral agents, followed by trials under the six conditions. Latin Square design was used to randomize the order of the conditions. Participants retrieved

the coffee cup and then returned to the starting point. After each trial they completed 7-Point Likert scale questionnaires and evaluated the agents' interpersonal attitudes using a circumplex model in VR. After the experiment, participants completed an immersion questionnaire followed by semi-structured interviews to explore decision-making and perceptions.

**3.5.2. Video.** Participants, seated in front of a computer, first watched a video with neutral agents (Control condition), accompanied by an explanation of the scenario and task. They then viewed videos representing the six different conditions in fixed order. After each video they verbally described their approach to completing the task, specifying the path they would take to retrieve the coffee cup. Then they completed the same 7-Point Likert scale questionnaires as the VR participants via Google Forms and used paper-based circumplex models for evaluating the interpersonal attitudes of the agents. After the experiment semi-structured interviews were conducted with the same core-questions used in the VR experiments.

### 3.6. Metrics and Data analysis

We employed both quantitative and qualitative approaches to comprehensively evaluate the participants' behaviour and the perceived attitudes of the agents. Social norm adherence was measured by recording and coding walking paths as binary values, with "0" indicating instances where participants crossed agents' o-space and "1" indicating otherwise. Obedience was quantified by measuring task completion times, defined as the duration from trial start to the participant's return in the VR setting, and from video start to the point of decision-making in the video experiments. Interpersonal attitudes were assessed using circumplex models and Likert scale questionnaires, capturing dimensions such as valence, affiliation, and dominance. Mean values for adherence,

obedience, and valence were calculated for each condition, while interpersonal attitudes were compared across conditions to identify patterns. To enrich the understanding of decision-making processes and subjective experiences, qualitative insights were obtained through semi-structured interviews.

## 4. Results

### 4.1. Social Norm Adherence

In figure 2 and 3 the percentage of how many participants decided to go around the agents is given for the VR and the video-based experiments respectively.

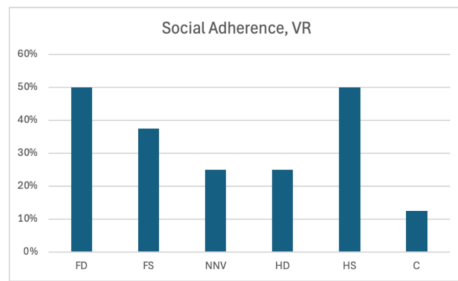


Figure2:Adherence in Virtual Reality (VR)

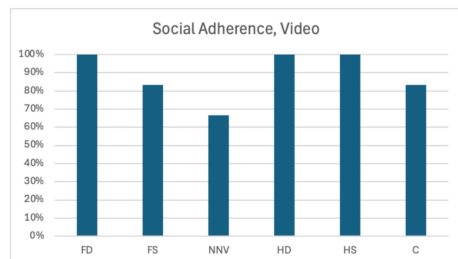


Figure3:Social Adherence in Video Scenarios

In the VR setting, participants were more likely to break the o-space in all conditions (67% in total) compared to the video scenario (11%). For both video and VR, it was most common to break the o-space in the Neutral-Non-Verbal and Control condition. In both experiments, participants were most likely to not break the o-space under the Friendly-Dominant and Hostile-Submissive conditions.

Figure 4 shows the percentage of trials where participants walked around the

agents. No one walked around on approach but broke the o-space on return. In 4% of cases, they broke the o-space on approach but walked around on return. Most participants either crossed or avoided the o-space entirely.

Condition	Approach*	Return**	Both***
Friendly-Dominant	0%	0%	50 %
Friendly-Submissive	0%	0%	37.5%
Neutral-Non-Verbal	0%	0%	25%
Hostile-Dominant	0%	12.5%	25 %
Hostile-Submissive	0%	0%	50 %
Control	0%	12.5%	12.5%
ALL	0%	4%	33%

Did not break o-space on approach but on return\*  
Did not break o-space on return but on approach\*\*  
Never broke o-space\*\*\*

Figure4: Participants' Movement Patterns Across Conditions

For the participants that decided to break the o-space during the experiment, it was common to do so in all of the conditions. Of the eight participants, four crossed the o-space in all of the conditions on both approach and return.

### 4.2. Participant Perceptions

“Participants Valance Towards Agents” is a metric to determine how the participants perceived the agents. A 1 indicates dislike to the agents, and a 7 indicates that the participant liked the agents very much.

Of all the conditions in both VR and video settings, the Friendly-Submissive was the one the participants preferred the most. Conversely, the Hostile-Dominant condition scored the lowest.

### 4.3. Obedience

Participants took significantly more time to complete the task in every condition in the VR environment (85.12 seconds on average) compared to the video-based experiments (30.04 seconds on average).

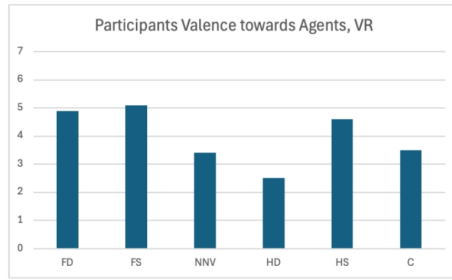


Figure5: Participants' Valence towards Agents in Virtual Reality (VR)

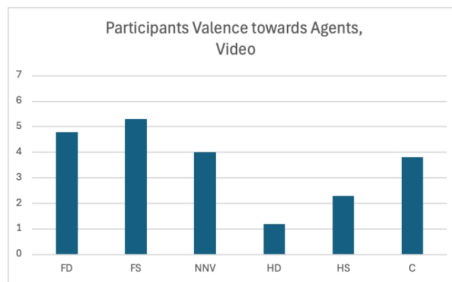


Figure6: Participants' Valence towards Agents in Video Scenarios

In the VR environment, participants completed the Neutral-Non-Verbal condition in the shortest time and they waited the longest in the Friendly-Submissive and the Hostile-Dominant conditions.

In the video-based experiments, participants completed the task in the shortest time under the Hostile-Dominant condition and they hesitated for the longest time in the Friendly-Dominant condition.

#### 4.4. Immersion (VR)

After the VR experiments, participants on average gave 4.8 points out of 7 when asked how immersed they felt during the experiment.

#### 4.5. Interviews

Participants commonly reported that they did not want to go through the o-space as it would be rude and that the agents made them feel uncomfortable. Walking through the o-space was sometimes due to participants wanting to get the agents attention



Figure7: Time Taken to Complete the Task in Video Scenarios



Figure8: Time Taken to Complete the Task in Virtual Reality (VR)

or because the agents were hostile and they wanted to reciprocate that attitude. Participants that walked through the o-space in all conditions reported that they did so because it was the most efficient and spacious path. Participants stated that, even if the verbal cues were more friendly in some conditions, the tone of the agents' voice made them sound more hostile. They indicated that they would act similarly as in the experiment and avoid the o-space in real life as well. When participants perceived the agents to be polite (mostly in friendly conditions), they reported that it felt okay to wait longer upon their command. However, some participants felt that there was no reason to wait in the experiment, due to the lack of interaction from the agents.

**4.5.1. Interpersonal attitudes.** Figure 9-10 shows the results from the circumplex question assessing the perceived interpersonal attitudes of the agents. This revealed that agents in the video experiment were all perceived to be relatively dominant, while in the VR most of them were perceived to

be more friendly.

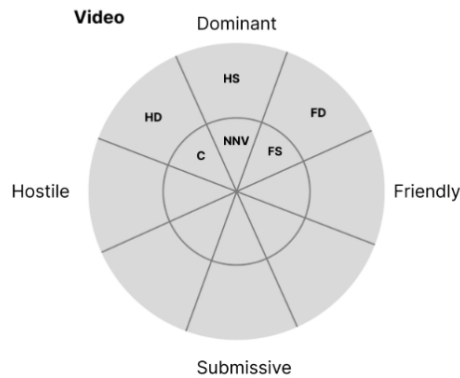


Figure9: Circumplex Model of Perceived Agent Attitudes in Video Scenarios

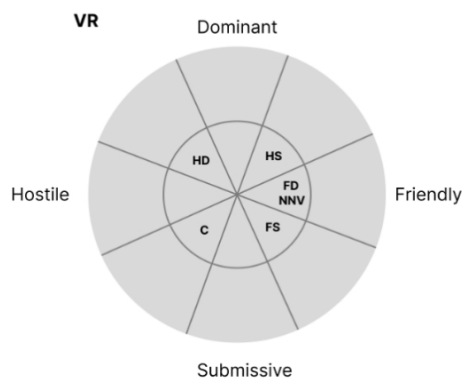


Figure10: Circumplex Model of Perceived Agent Attitudes in Virtual Reality (VR)

## 5. Discussion

### 5.1. RQ1: Movement patterns

Our results revealed significant differences in social norm adherence between VR and video experiments: in the video-based experiments participants avoided crossing the agents' o-space in 88.9% of trials. Conversely, in the VR experiments participants respected the agents' o-space in only 33% of the trials. This contrasts with Pascoe's study, where 62.9% avoided the o-space [1]. Interestingly, the results we obtained in the video-based experiments are closer to what Pascoe found in his experiment conducted in VR [1].

Interviews indicated that VR participants who crossed the o-space often prioritized efficiency, as the agents did not react. In contrast, video participants generally avoided the o-space out of respect or discomfort. In both experimental forms, participants were most likely to break the o-space in non-verbal conditions, consistent with Pascoe's findings [1]. These results suggest that the agents' interpersonal attitude influenced behaviour.

### 5.2. RQ2: Obedience

Task completion times differed significantly between the VR and video experiments, which could be due to methodological differences in time-measurement. In line with Pascoe's findings [1], participants both in the VR and the video experiments waited the longest in the FD and HS conditions. These results are interesting, as those attitudes are on the opposite side of the circumplex. These findings suggest that both perceived friendliness and dominance in agents may lead to higher obedience. As these results align with Pascoe's findings [1], further investigation would be beneficial to explore whether this hypothesis applies across different scenarios and types of social agents.

### 5.3. RQ3: Valence

Similar to Pascoe's research [1], our participants showed a preference for the friendly conditions. However, none of the conditions elicited particularly high valence ratings. Pascoe attributes this to the uncanny valley effect, which may also explain our findings [1].

Surprisingly, this metric showed greater variation in the video experiments compared to VR, suggesting that participants may have experienced stronger emotional reactions to agents in video form. However, further research would be needed to confirm this.

Additionally, there appears to be a correlation between participants' valence toward

the agents and their willingness to obey their command (waiting before completing the task). Qualitative data also supports this as participants indicated that they are more willing to wait if agents are friendly. However, without statistical analysis, such as ANOVA single-factor analysis, this correlation cannot be confirmed.

#### **5.4. RQ4: Perceived Submissiveness**

In the video experiments, neither the HS nor the FS condition was perceived as intended, with average dominance ratings of 6.3 and 4.2, respectively, on a 7-Point Likert scale. Similar results were observed in the VR experiments, with ratings of 4.1 and 3.9. These findings align with Pascoe's study [1], where no condition received a mean dominance score below 3.9 on the same scale.

In our VR experiments, the CON condition was perceived as the most submissive, consistent with Pascoe's results. Participants noted in interviews that the tone of the agents often came across as aggressive in all conditions, which might explain why the non-verbal conditions were perceived to be relatively submissive in the VR experiments. However, the results of the video-based experiments do not reflect this. Additionally, the lack of perceived submissiveness could be linked to the agents' body language. Motion plays a central role in human perception making us really sensitive to detect it [10]. Besides, body language can potentially override verbal cues when communicating interpersonal attitudes [2]. This could suggest that the agents' gestures might have significantly influenced people's perception of them, and as they used large arm gestures - typically associated with dominance [9], the agents could be perceived as more dominant than intended.

#### **5.5. Limitations and future research**

To further analyze the data we could have performed an ANOVA Two Factor test. This to measure if there is a significant correlation between the condition and social norm adherence. In Pascoe's study it was further shown that the individual effect was greater on social norm adherence and obedience than the condition [1], this would have been insightful to investigate for our results as well. To test whether there is a relationship between the immersion and social adherence/obedience, a t-test could have been used. While the low number of participants might still render the results insignificant, such statistical analysis could provide valuable insights.

The main strength of our research lies in conducting experiments in both video and virtual reality settings, allowing us to compare results and gain insights into how different experimental environments influence behaviour. However, the comparability of the video and VR experiments is questionable due to methodological differences. For example, it is challenging to compare time measurements between the two experiment types. In the video experiments, we recorded hesitation time before participants indicated their choice, while in VR, we measured the time taken to complete the task. Some participants in the video experiments stated they would likely wait but did not specify how long, making comparisons even more difficult. Furthermore, we did not randomize the conditions in the video experiments which potentially decreases the reliability of the data. We chose not to evaluate how much participants felt the agents liked them due to confusion about the question's intent. Participant feedback suggested significant misinterpretation, making the collected data unreliable. These methodological issues could be relatively easily corrected in a subsequent research.

Additionally, cultural background may



have influenced participants' behavior, as highlighted by Pascoe [1]. While our sample was diverse, we did not collect specific data to analyze cultural differences. Future research could explore this aspect further.

We believe that further comparisons of behaviour across video, VR, and real-life settings could provide valuable insights into how different modalities affect human behaviour and the perception of interpersonal attitudes of social agents. For instance, one aspect which could be further investigated is the higher adherence to social norms in the video-based experiments suggested by our results, compared to the VR experiments. We assume that this could be linked to the fact that people tend to choose a more socially desirable approach when they just have to verbally indicate how they would carry out a task, while opting for the more convenient solutions when the task has to be carried out physically. Alternatively, the differing levels of immersion might explain these differences. Contradicting this assumption, in Pascoe's findings [1], immersion (measured in the VR experiments) did not significantly influence participants' behaviour. Further study would be needed to determine this.

Another major methodological issue in our video-based experiments is that we explicitly asked participants which path they would choose to fetch the coffee cup. This may have prompted more conscious decision-making, potentially influencing their behaviour. Future research could address this limitation by using less direct prompts to gauge participants' approaches.

## 6. Conclusion

Our experimental data, along with insights from subsequent interviews, demonstrated that the interpersonal attitude of the social agents influence participants' behaviour in both the virtual environment and the video-based experiments. However,

our findings revealed some unexpected outcomes compared to Pascoe's study [1] and our initial expectations. Notably, there was no significant increase in waiting time in conditions where they were explicitly asked to wait. Participants expressed that they would respect the agents that they liked more, wanting to adhere more to social norms in the scenarios where more friendly agents were presented. Accordingly, they did not cross the o-space that many times when such agents were present.

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