

# Behavior vs Appearance: What Type of Adaptations are More Socially Motivated?

Extended Abstract

Diogo Rato  
INESC-ID, Instituto Superior Técnico  
Universidade de Lisboa  
Lisbon, Portugal  
diogo.rato@tecnico.ulisboa.pt

Marta Couto  
INESC-ID  
Lisbon, Portugal  
marta.couto@gaips.inesc-id.pt

Rui Prada  
INESC-ID, Instituto Superior Técnico  
Universidade de Lisboa  
Lisbon, Portugal  
rui.prada@tecnico.ulisboa.pt

## ABSTRACT

For autonomous agents to successfully perform in open hybrid scenarios (with people and agents), they need to adapt to different social contexts. Simultaneously, the people involved must understand the observed changes in the agents, particularly to identify the social motivations for such behavior. In this paper, we report an experimental study conducted to assess if an agent's behavioral changes (gait), are perceived as more socially motivated than its appearance adaptations (color). Furthermore, we explore if other agents' presence and behavior affect the attribution of motivations. Our findings suggest that external observers identify agents' appearance adaptations as more socially and spatially motivated than behavioral changes. Furthermore, the agents' awareness is rated higher when the agents adjust their physical characteristics compared to behavioral adaptations.

## KEYWORDS

Social Motivation; Behavior Attribution; Social Cognition; Human-Agent Interaction; User Studies

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## 1 INTRODUCTION

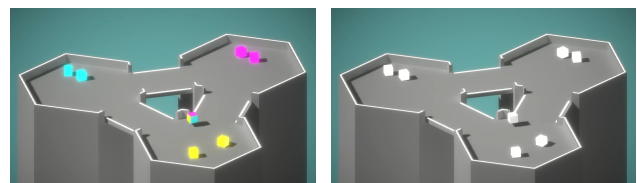
Humans exhibit the capabilities to adjust their behavior and appearance based on their surroundings. When placed in a formal setting, most people would attempt to adhere to an adequate dress code. Similarly, when visiting a causal environment, such as a public park, most people would consider exercising as an adjusted activity for that context. Most humans can identify the implicit norms of different contexts and adapt their behavior and appearance accordingly. Similarly, an agent which behavior is interpreted as adjusted and adapted to its social context can indicate that the agent displays socially intelligent behavior. [11]

Towards creating hybrid societies of agents and humans, the former must possess mechanisms to identify what is socially affordable based on its surroundings, including other social actors. Still, interpreting a situation is a subjective task since it depends on the frame

of reference of the observers. The perceiver's motivations influence the interpretative process, expectations and past experiences [4] and each perceiver's interpretation might lead to divergent notions of adequate and adjusted behaviors [7]. Furthermore, during attitude construal, others' interpretations of the situation play a role in better assessing the situation [8], thus, attempting to create agents that only account for their point of view, might harm their chances of being perceived as socially intelligent.

While agents are becoming more ubiquitous, their autonomy should take into account the environment's physical elements and the social meaning of other actors [2]. Enabling agents with processes to understand what is adequate for each social context and adapt to it will increase their chances of matching an external observer's attributed motivations. However, there is a vast range of adaptations an agent can perform and significant variability in the social contexts. As such, an external observer might perform varied attributions based on the adjustment and the surroundings.

In this research work, we explore how an external observer ascribes motivations to autonomous agents adaptations in a virtual setting. In particular, we want to explore how the adaptation of behavior, represented by the agent's gait, and appearance materialized in the agent's color, can promote distinct attributions of social motivations. For this study, we chose appearance and behavior represented as color and gait, respectively, since these two features depict common traits found in agents. By contributing with a more robust understanding of how external observers ascribe social motivations to agents' appearance and behavior changes, researchers and developers can better tailor agents' adaptive mechanisms to align with others' expectations.



(a) Agent adapting to others' color (b) Agent adapting others' gait

**Figure 1: Two variations of the scenario: (a) the main agent is changing color and (b) the main agent is changing gait to others salient norm.**

Similarly to Heider and Simmel experiment on the apparent behavior [3], we relied on a minimalist representation of agents,

cube-shaped characters, that can change their behavior, represented by their gait, and appearance, represented by their color, as shown in Figure 1. Each agent implements a simplified version of the Cognitive Social Frames model [6].

Motivated by Theory of Mind’s first precursor, the intentionality detector [1], we hypothesize that people may be more inclined to view changes in gait as more intentional and socially motivated than changes in color since color changes can be viewed as an adaptation mechanism that is less controlled than choosing the manner of the movement.

**HYPOTHESIS 1.** *Participants will attribute higher values for social motivations and adaptation to the agents’ behavioral changes (matching the gait of other cubes) than to the agents’ appearance changes (matching the color of other cubes).*

Additionally, we hypothesized that when the surrounding agents exhibit the expected behavior and appearance - the salient norm - it will positively influence the attribution of social motivations and adaptive capabilities.

**HYPOTHESIS 2.** *Participants will attribute higher values for social motivations and adaptation to the agents, when the norm is salient, i.e., when the other agents in a room display the target gait or color.*

The findings of this study can contribute to the development of social agents that should be perceived as socially adequate to their social context. More specifically, our results identify, in a limited domain, which characteristics increase the chances of making an autonomous agent be perceived as socially motivated.

## 2 EXPERIMENT

We employed a mixed design 2 (Adaptation: Color vs. Gait) x 2 (Norm Salience: Salient vs. Not salient) with Adaptation manipulated within-subjects and Norm Salience as the between subjects factor. We recruited 115 participants from Amazon’s Mechanical Turk and 35 were eliminated prior to data analysis for failing the attention checks. As such, our analysis includes the remaining 80 participants: 27 women, 51 men and 2 others. Participant’s ages ranged from 23 to 69 with a mean age of 37.86 ( $SD = 11.03$ ).

Each participant saw two 220 seconds videos of the agents moving across multiple rooms. The only variations observed were on the cube’s gait and color and the norm salience of other agents. The main character visits each room three times starting on the left one and follows a clockwise sequence. After visiting the three rooms, the remaining agents change rooms following a counterclockwise rotation. As such, the main character meets all the other groups in the three rooms. In both videos each participant watched, all agents had their norm either salient or not salient.

We used the Social Motivation of Intelligent Agents Scale [5]. The scale has 18 items, divided in 4 factors (1) Social motivations with 5 items, (2) Spatial motivations with 2 items, (3) Awareness with 5 items, and (4) Agency with 6 items. Also, we wanted to assess participants’ perceptions of adaptive behavior and so, inspired by the Diagnostic Adaptive Behavior Scale DABS – factor social (e.g., [9]), we created 7 items to assess what adaptive behaviors were recognized on the cube.

Additionally, we asked people to explain, using their own words, the main characters behavior on both videos by answering to some

open-ended questions. Among the 78 valid responses, participants highlight the following aspects of the adaptations:

- **the motivation** - 73.0% mention what influenced the the cube’s changes of behavior and appearance (e.g., “*I think it was trying to appeal to the other cubes in each room, trying to be accepted.*”, “*The cube was changing colors as it entered different rooms and following the other cubes around each room. It was trying to adapt to the different social environments.*”);
- **the objective** - 42.3% mentioned why the cube changed its gait and color (e.g., “*Was trying to socialize with the other cubes.*”, “*I think the cube wanted to be included and was trying to find a group that would include him.*”);
- **the means** - 46.2% of the replies attempted to explain how the cubes were adapting their behavior (e.g., “*adapting to fit in with the cubes in its closest proximity*”; “*It was copying the style/behavior of each pair of cubes in order to fit in better.*”).

Regarding Hypothesis 1, we did find a main effect of behavior. However, motivation scores were higher for color changes than for changes in gait. Movement is essential for attributions of animacy (e.g., [10]), and one can easily argue that there are no inferences of intentionality or social motivations if there is no animacy. However, it seems color changes did cause a higher-level perception of social motivation, which we did not anticipate.

According to Hypothesis 2, we predicted that participants would attribute higher values of social motivations and adaptations when the norm was salient. However, we did not find a main effect of salience and, therefore, did not confirm Hypothesis 2. This result is surprising as we expected people to attribute significantly more social motivations when they see that the agent is adopting the same behavior (gait) or appearance (color) as the other cubes, but this was not the case. Consistency and persistence seem to be more informative for participants than salience of the norm being followed. Additionally, it is important to highlight that the use of a minimalist scenario with cubes, although it might mitigate some of the problems associated with cultural and societal bias, they might also affect the participant’s attributions.

## 3 CONCLUDING REMARKS

In this work, we studied if the behavior and appearance of agents, as well as the salience of the norm, would affect an external observer perception about a virtual agent’s motivations. Our findings suggest that an external observer ascribes social motivations and adaptive capabilities to a simple cube shaped character. Furthermore, our results indicate that adaptation based on appearance, its color, is perceived as more socially motivated than behavioral changes, its gait. Also, when rating the cubes’ agency, participants gave higher scores to the gait adaption rather than the color one, but only when the norm was salient.

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