An Interactive Space as a Creature:
Mechanisms of Agency Attribution and Autotelic Experience

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ABSTRACT

Interacting with an animal is a highly immersing and satisfactory experience. How can interaction with an artifact can be imbued with the quality of an interaction with a living being? The authors propose a theoretical relationship that puts the predictability of the human-artifact interaction at the center of the attribution of agency and experience of "flow." They empirically explored three modes of interaction that differed in the level of predictability of the interactive space's behavior. The results of the authors' study give support to the notion that there is a sweet spot of predictability in the reactions of the space that leads users to perceive the space as a creature. Flow factors discriminated between the different modes of interaction and showed the expected nonlinear relationship with the predictability of the interaction. The authors' results show that predictability is a key factor to induce an attribution of agency, and they hope that their study can contribute to a more systematic approach to designing satisfactory and rich interaction between humans and machines.

KEYWORDS

Agency, Alive, Animate, Flow, Intelligent Environment, Mixed-Reality, Predictability

INTRODUCTION

Interaction with animals can be regarded as the gold standard of a rich, engaging, and gratifying experience where the user is fully immersed and focused (Beetz, Uvnäs-Moberg, Julius, & Kotrschal, 2012). It would seem that interacting with things that are alive has a quality distinct from an interaction with inanimate matter. In order to purposefully build systems that are seen as alive, we need to understand what inferences humans are making. The distinction between what is alive and what is not is a fundamental perceptual category in humans (Wiggett, Pritchard, & Downing, 2009) that can be regarded as an "evolutionarily adapted domain-specific knowledge systems" (Caramazza & Shelton, 1998). The fundamental nature of this faculty is highlighted by the fact that already young infants seem capable of distinguishing animate from inanimate (Poulin-Dubois, Lepage, & Ferland, 1996; Schlottmann & Ray, 2010). We know factually that entities that are alive, entities that look alive, and entities that display agency belong to three distinct but intersecting sets (Figure 1a). The relevant question in our context is what subjective heuristics people use when making inferences based on observation of, and interaction with an entity. It is known that humans use a number of rules

Figure 1. (a) Entities that are alive, entities that look alive, and entities that display agency belong to three distinct but intersecting sets. (b) Proposed heuristic used for determining if an entity is alive.

(a)   (b)
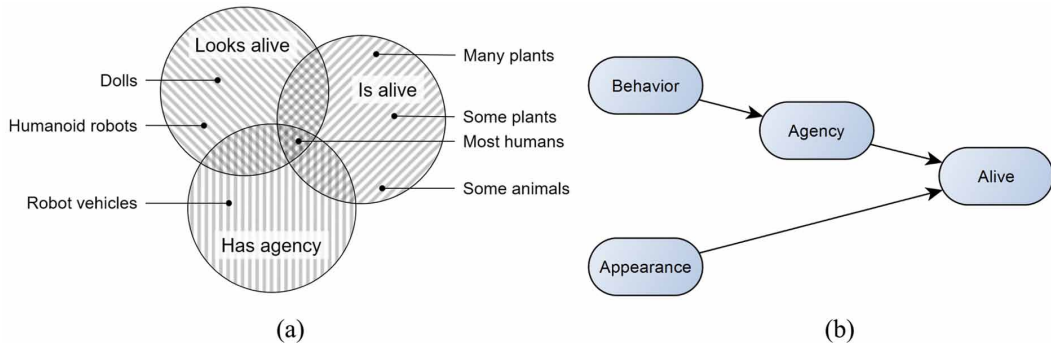
such as presence of face-like feature, and movement to determine what is animate (Jipson & Gelman, 2007). We hypothesize that the main factors for the attribution of animacy are the appearance and the (assumed) agency of the entity. Agency, in turn, is inferred from the observed behavior (Figure 1b).

In other words, we are assuming that the factors of attribution of animacy can be divided into static (appearance) and dynamic (behavior). The notion that behavior is a factor that is distinct from appearance comes e.g. from studies of the perception of animacy in abstract shapes moving in biologically inspired ways (Scholl & Tremoulet, 2000).

Though the mechanism of animacy attribution will not be entirely trivial, we assume that the factors "agency" and "appearance" will, by and large, contribute in an additive fashion to an attribution of animacy. Interesting scenarios will arise when there is a disparity between the two factors: We assume that a low level of agency combined with an appearance that strongly suggests animacy, leads to the "uncanny valley" effect (Mori, 1970). In the present study, we investigate the inverse case: The combination of high agency with an appearance that is not lifelike. Specifically, we are investigating factors of the interactive behavior that lead to an attribution of agency. We are interested in identifying those characteristics of interaction that lead to an attribution of agency, and how this is related to specific kinds of user experience.

Most studies investigating factors of agency use a passive paradigm where participants observe pre-recorded stimuli (e.g. Schlottmann & Ray, 2010). In our study, we investigate attribution of agency through a real-time interaction with an artifact. To bypass the influence of appearance factors we exploit an artifact that is explicitly non-anthropomorphic: An interactive mixed reality space. The viability of this approach is grounded in earlier work developed in a similar space where we were able to show that humans do attribute the property of entity to the interactive space "Ada" (Eng, Douglas, & Verschure, 2005; Eng, Mintz, & Verschure, 2005). In the present study, we use a system that is a further step beyond Ada called eXperience Induction Machine (Bernardet et al., 2011).

Dynamic Factors of Agency Attribution

In the present study, we focus on the dynamic factors that contribute to an attribution of agency, namely the temporal and probabilistic predictability of behavior. Our first hypothesis is that the level of predictability of the behavior of an object leads to the attribution of agency. Support for this notion comes from research on biological motion, that shows that one of the characteristics of biological motion is to be unpredictable (e.g. Mandler, 1992). To test this hypothesis, we designed and tested three modes of interactions. In these interactions, the internal logical behavior was the same but we introduced different factors of uncertainty and probability to increase the complexity of the interaction. A highly predictable interaction with the space means that it is always responding in the same way to the user's behavior. A medium predictable interaction means that the space not always will react in

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