Cody Frost | Professor De La Cruz | Applications | Dec 5 2025

Robot Intelligence in the Mind

Robot is a stage name, a fantasy. The first robot was Prometheus. The second robot was some guy in a play. Ever since then it's been messy business drawing lines of any sort between machine and robot: the full actualization of the latter ever resting in the land of fantasy. They need to be smart enough to solve nagging, menial problems. Smart enough, even, to reach a level of labor capacity where humans are freed from their shackles of want. But they can't be too smart, lest they strip humans of their choice, dignity, and workforce. Won't intelligence mean they view themselves as superior and try to kill everything under them? This relays the fundamental struggle of the robotic fantasy, we dream they will be as intelligent as we are in the magnitude of labor but not so that they feel its pains and explorations and as we do, drive history forward in class struggle. Lucky for us, it's hard enough even getting them to act in ways function meaningfully for us at all, so this dialectic struggle is far off to say the least. In this question "meaningful function" robotic intelligence remains central. If robots are to be as useful as intelligent laboring machines they must be more capable broadly speaking than animals, and so, at least that smart insofar as they are perceived. We now have some robots which are beginning to operate on this level and edging into the territory of the animal.

In this essay we will create a theory intelligence as based in perception and leverage it to analyze robots. We discover that intelligence hinges not on what a machine actually knows, but on how it moves and signals intention through forms we recognize from our history with animals. By contrasting two mainstream forms of robots consumers are likely to interact with, Roombas and Waymos, we will see how the perception of intelligence is used both to make

robots more or less compatible at sharing space with humans. Designers can leverage this perceptual gap—the chasm between minds where we project intelligence onto the Other—to foster empathy and cohabitation, or they can ignore it in favor of market efficiency. The stakes of this choice are becoming concrete as autonomous machines increasingly share our spaces.

Why set the bar for intelligence with animals? So then the intelligence of forms of matter like trees must be examined. Are we to say that trees are not intelligent? Certainly there is some will there by which matter is continually organized and reproduced. A tree is able to deploy an intuitive understanding of place enough to develop roots and leaves if its initial conditions allow for it. I think a tree falls flat, though, due to the scale of time from which it is perceived relative to individual human observers. We never get the chance to determine if the actions a tree took were correct or not. I think this is inherent in recognizing our biases as weighted towards forms of intelligence which are similar in duration and place to ours.

So then this question of medium through which intelligence is expressed becomes really central to how we have to think about designing intelligent robots which perform in satisfying ways. Unfortunately, intelligence is sort of a black box. If we really wanted to know how intelligent something is we would have to mentally cohabitate, an experience currently made impossible by limitations in the physicality of place. Very sad. We are separated from each other and from god on the mental and physical level; inherently any view of any other is a crossing of this chasm. We are forced to build assumptions and create an idea of the Other which we can never validate in this mental gap. Intelligence is a black box. We are forced to make assumptions to its presence. This is where we are at our limits. Our perception of intelligence in the other is

like spotting a light house at night on a distant shore but, reality has proven the night is full of stars.

This chasm is the place where minds can dream and play. This is where we can intervene, this is where philosophy happens, where the intelligence divide can be constructive, where we have in the past enchanted the world and where we will continue to again and again. This is where elements of the world play to bridge that gap from mind to mind as we encounter another minds presence in intermediary form. This is where we can recognize common forms of thinking creatures like heads, eyes, ears (Breazeal, 708). Traits like the particularities of movement, smell and sound are rich here as well. Physicality in these forms draws from our intuitive understanding of animals, as opposed to other possible potential investigation forms of intelligent self organization like trees. This is the ideal space to situate grasps at robotic intelligence because human beings have a long and rich history of design collaboration with animals, the territory is known.

So as we recognize the reception of intelligence is deeply rooted in perception, but also in the physicality of place. Obviously, because the thing as intelligent or must be a thing we judge, a thing which exists, but also because it must move through existence at a similar speed, roughly speaking, as we do. Human perception is very sensitive to movements in this range (Hoffman, 89) and so these experiences of perception of intelligence are often fundamentally tied to movement, both micro such as located on body, a twitch of the eye or macro such as body through space, walking across the room.

Isolating these actions to that of movement through space. The baseline criteria for success is the perception of contemplative action. The perception of intelligence here is in

existence through a prediction reaction framework. If I step here, it will be stable, and I can take another step, and it will be stable. This type of action of movement is encoded in the form of the thing which is viewed, an intuitive sense of movement is a fundamental sign that we look for when finding intelligence, something a bird has that a boulder lacks.

A boulder follows a single impetus, that of gravity, and thus behaves predictably. Its movement is lifeless. If it could stop for a second, shudder, and choose another course, we would pause for a second. If it rolled up the hill, around an obstacle, and then continued down, we might say, oh look at that, it really wants to go down the hill. It has a desire. It must be capable of desiring.

This has been a successful strategy for robotized intelligence to move a form through space, the simple repetition of bump into something, turn, move, do I bump? Turn then and move, if no bump, movement continues etc on and on. This simple strategy of action first orientation to the robot control problem was pioneered by Rodney Brooks with incredible walking robots like Genghis, and later debuted on the market in the first Roombas. Since then, strategy for robot vacuums has changed due increased access to computation, favoring a mix of lidar sensor mapping, memory and traversal strategies, but when push comes to shove, when facing a barrier they don't understand good old fashioned bump and run returns, my "roborock" thoroughly investigates the mirror just to make sure it can't go in.

Here we have assumptions the robot is programmed to make guiding its interactions with physical space. It will never learn something new, its use and purpose is formed by its design as an object. The orientation the roomba has adopted to navigate its surroundings and perform in its niche scenario preclude it from operating otherwise. Robots only grow and change when they get

remade. Even so, this limited existence is highly convincing. The automatic vacuum cleaner is a simple robot which performs a limited action and yet has become a space where intelligence is found. As far back as 2007 there are reports of people demonstrating emotional attachments to primitive roombas. (Sung, 1). The roomba has successfully entered the domestic environment because it operates effectively in its labor and appears intelligent enough to warrant social bonding. The roomba throws light out into the void and lets us imagine it as a distant shore. The roomba has a purpose and a mechanism to complete that purpose we read all sorts of desires and wants, enough to modify our environments to accommodate its drive and desires. The roomba does not need to be a human, but it does need to join us in wanting a clean floor.

It's almost cliché, but now let's talk about autonomous vehicles. Fundamentally, both robots operate by moving through space, (this is a very common theme for what we image robots doing). This comparison is apt as well because roomba is 20 years ago, and autonomous vehicles are just beginning to breach the market. Both robots operate by traversing their environment, fundamentally both built environments, one across place, one from place to place. Obviously bump and run needs go, but we can replace it with lidar remote sensing. The desire to vacuum a whole floor becomes the desire to move through an urban landscape. So far, self driving cars have proved successful navigating their environment (the easy part), but struggle on interactions with people not inside them. Right now, we are seeing how this interaction will work out.

Most of the time spent driving is spent viewing other cars as anonymous vehicles, but the dynamic changes at stoplights. When drivers and pedestrians interact eye contact and gesture are important channels of information for communication as language is blocked off. With autonomous vehicles there is no individual to make this connection with (Fowler). The car

signals its intelligence to us by moving cohesively given the environment but is unable to express its desire to move through particular space in complex interactions with humans. It's pedestrians who lose the most through interacting with this dumb object, continuing long trends of design with cars, Waymo continues to center driver to driver interaction.

What would a hri approach to autonomous vehicles that centered humans look like? For one thing, it would have eyes. Eyes are proven to be effective in human robot interactions and in human car interactions. This allows the robot to show attention and engage humans for signaling desire. Redesigning the interaction so that the humans see the car as intelligent is crucial for establishing co-empathy for the robot as a member of shared living space. Programming the eyes to convey what types of information they're integrating allows people to intuit the machines intentions.

It's really not even that big of a sell. I'm not asking for the whole car to get remade as like a big soft blob or that they get stuffed underground or anything crazy like that. I just want to live in a future where we can keep some of the ways that vehicular movement has changed us with touted benefits of removing humans drivers from the loop, like safety, parking redistribution, and less total energy usage. Even if the robot car totally sees you stalling and rolls its eyes and California stops that would be better than the current reality with the featureless autonomous vehicles we suffer

The problem is they're such cursed object, cars. Rescuing "automatic human delivery robot" from the territory of car is *the* human robot interaction challenge. There have to be countless hri experts employed at toyota, google, tesla, and I'm sure every single one of them has read the papers I cite here but again and again they choose to design the autonomous cars

without eyes. They've barely even tried, Jaguars goofey example being one of the few prominent in real life studies (Jaguar's Virtual Eyes in Self-Driving Cars). I think they want autonomous cars to stay threatening and inexpressive. Just like the way consumer cars are designed. Like orca whales. Recently Waymo has altered the algorithm to make their vehicles more aggressive. Commercial autonomous vehicles are becoming more and more hyperactive in a race to the bottom in terms of market efficiency for people moved and the people, literally, they are racing against, literally, are human drivers. Putting eyes on the car admits too much emphasis on adverse users (pedestrians) and thus detracts from market efficiency (Bindley). This issue reveals the frailty of design which is not co-intentional with the broader material structures of production. The success of hri elements to embody intelligence in the roomba is driven by its existence as a commercial product in the home. A field with a long tradition of successful automation. As long as autonomous cars are faster ignoring people, being rude, as long as they operate by cheating the rules, cutting people off and behaving unpredictably, they will.

There is clearly potential for intelligent robots to intervene in our labor environments. This can happen in a mindful way where human and robot interaction is treated as a way induce the mind towards empathy and attachment as with the roomba or in a way which signals danger and supremacy of the machine as with Waymo's. It's a great time to be alive if you're interested in watching this interaction unfold as we see more and more autonomous vehicles, among other robots, creep into our lives. We know if they can fulfill some basic perceptive formation in our minds we will read them as intelligent, but the nature of that intelligence will be determined in context as our relationship to our creations reflect current material conditions.

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