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Traffic Light Intersection as a Cognitive System

Distributed cognition is a framework to understand cognitive systems. Its fundamental premise argues that cognition emerges from the interactions between the different agents of a cognitive system (Hutchins 2001). This paper will focus on a four-way traffic light as a cognitive system.

Unit of Analysis:

In a four-way traffic light, there are various cognitive agents with a functional relationship and role in the cognitive processes occurring in the overall system (Scott 2019). The agents include the drivers and cars waiting on all four sides, the pedestrians, and the physical traffic lights and street signs. The unit of analysis for this four way traffic light will focus on the individual interactions between a driver in their car and a pedestrian, the material environment with the traffic light and street signs, and the cultural elements which factor into how the driver also interacts with their environment at a traffic light. The cars at the traffic stop are a unique cognitive artifact being used by the humans to distribute the cognitive labor. This paper will not focus on the myriad of interactions between a driver and their car, but rather will focus on the overall functional role a driver and their car have in relation to the overarching traffic light cognitive system. For this assignment, the boundaries imposed by the unit of analysis will ultimately help focus the cognitive consequences to the specified components of a traffic light cognitive system.

Cognitive Achievements and Emerging Properties

Before analyzing this traffic light system through the distributed cognition framework, it is important to understand the cognitive achievements and emergent properties of this cognitive system which highlight the overarching goal of the system (Scott 2019). Through all the

interactions and coordinated movements in this traffic light intersection, the driver in the car wants to make an unprotected left turn while a pedestrian wants to cross the street and the cars around them want to move through either left or right turns or by going straight down the intersection. And ultimately as a single cognitive unit, the cars, pedestrians, and physical traffic light and signs form a functioning intersection on the road that keeps traffic moving. And a traffic intersection is more than the interactions and desired cognitive accomplishments of the individual drivers, cars, and pedestrians making up the unit of analysis or system.

Distributed Cognition Framework

But in order to understand the emergence that arises through the organization of cognitive agents in this system, I will discuss the division of cognitive labor, propagation of representations, coordination amongst parts, and temporal distribution within this traffic light system (Scott 2019).

Division of Cognitive Labor

The division of cognitive labor in this system occurs between the agents mentioned in the unit of analysis. There is a person driving the car and there are people crossing the street. A significant portion of the cognitive labor is offloaded to the traffic light which dictates the temporal distribution of how the different agents of this cognitive system interact. In other words, all the cars and pedestrians involved in this cognitive system rely on the indicators of the traffic light to be able to complete their desired cognitive achievements. According to John Sutton, there is an integration of external tools in distributed cognition (Sutton 2006). Although tools like traffic lights and street signs do no cognitive work on their own, a person knows when to cross based on the crosswalk sign indicator in the traffic light. The drivers in the car know when they can drive based on when their respective traffic light turns green. And the street and

traffic signs surrounding the intersection also play an integral in the division of cognitive labor in the material environment. Rather than having to remember the street names and specific legal rules to follow in each intersection, the material environment including the street and traffic signs are used to amplify the cognitive abilities of the users of the cognitive system (Hutchins 2001). This goes to demonstrate the necessary external systems needed for this cognitive system to function as a whole.

Representations and Coordination of Parts

The representations present in this cognitive system help facilitate the interactions between the different agents (Hutchins 2001). The traffic light has three possible lights: the top red, the middle yellow, and the bottom green light. The red light leads to a representation that propagates through the system that leads to cars choosing either stop moving or remain still in their current location. The yellow light conveys cars to yield whereas the green light signals the cars to move and keep crossing the street. The different lights have legal meanings; however, how the way that property moves through a cognitive system can be different and thus lead to misrepresentations that propagate through the system.

Certain drivers see a yellow light and choose to speed across the intersection, while other drivers slow down and stop. This relates to the culture schema surrounding how drivers interact in a traffic light regarding the beliefs of when to stop, yield, and go (Scott 2019). For the drivers that speed across at a yellow light, occasionally the light turns red before they've crossed the street leading to a red-light violation. How the way each car interacts with the representations propagated through the traffic light not only impacts the overall cognitive system but also micro-interactions. Each driver has to take a call based on their own experiences with going through traffic lights. But the behavior of one car impacts the behavior of the cars around it. In other

words, how representations are propagated through the system shapes the resulting coordination of parts which ultimately impacts how a cognitive system achieves its cognitive accomplishments.

Another representation includes the driver in the car using their left turn indicator to communicate with the pedestrian and the fellow cars about their specific goal in this cognitive system. Once the pedestrian recognizes this representation, there is often a gesture exchange between the driver and the pedestrian. The purpose of this gesture exchange is to confirm whether the driver and pedestrian agree on the cultural schema of who has the right of way to go first in across the street. Generally, the pedestrian has the right of way. However, if the pedestrian is further away on the crosswalk, the driver may choose to take their left turn first breaking that cultural schema. This specific gesture can be classified as an emblem gesture based on the cultural conventions of this cognitive system. Gestures are an intermediated system which highlight the situated nature of cognition and the role of perception and action in dictating the nature of interactions between pedestrians and drivers (Vasc 2016). This gesture exchange also relates to Sutton's view of embodied cognitive capacities being part of the cognitive system (Sutton 2006). Overall, gestures are a significant part of how drivers and pedestrians use the social resources available to them to interact with the system and environment.

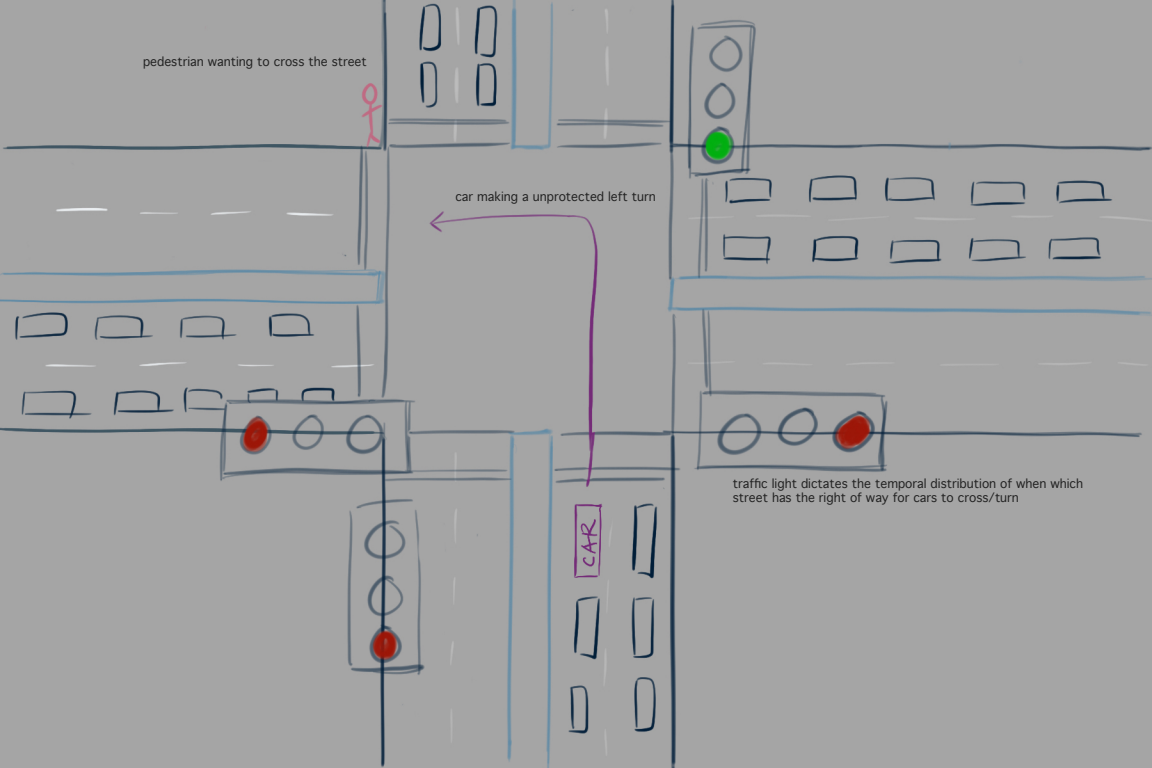
Temporal Distributions

The function of the entire cognitive system depends on the temporal distributions within the system. All the cars on the four sides of the intersection wait on their turn to drive based on the time scale dictated by the traffic light. Once a street intersection has a green light, the pedestrian has the right of way to cross the street while the cars around them make turns or go straight ahead. And once that traffic light rotates back to red, another street receives the green

light indicator from the traffic light. And this temporal structure is the key to a functional traffic light intersection.

Conclusion

Overall this paper demonstrates how cognition is distributed in this traffic light cognitive system. The traffic light system also revisits the importance of communication as a fundamental concept for understanding cybernetics and how technology has integrated into our lives. The traffic light cognitive system specifically focuses on the communication between individuals and the environment through the physical traffic lights, street signs, and gestures used between drivers and pedestrians. And relating back to Noe's enactive approach, perception is action oriented (Noë 2006). For the traffic light, the individual interactions between the cognitive agents in this system stem from physically moving through and interacting with the system. Pedestrians have to start moving to cross the street to better understand the affordances of the system and how to reach their desired cognitive accomplishments. The driver making the left turn has to move towards the middle of the street and interact with the environment through the use of a left turn signal and gestures. This makes the underlying theme of this traffic light system to be interaction. Ultimately, understanding the different levels of interaction is imperative to understand and analyze a cognitive system.


pedestrian wanting to cross the street
car making a unprotected left turn
CAR
traffic light dictates the temporal distribution of when which street has the right of way for cars to cross/turn

Works Cited

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