Pragmatic delegation of work by humans and machines

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ABSTRACT

Delegation, where work is carried out by an agent on behalf of a principal, necessarily involves coordination. The coordination of delegation occurs within an organizational context where social norms guide interpretation of the principal's and agent's actions. Here, we develop an integrative theory of the norms of delegating work within an organization. Our theory, inspired by pragmatics research studying the effect of context on interpretation of language, centers around nine norms that we propose govern acts of delegation: the maxims of alienability, feasibility, authority, responsibility, transparency, comprehensibility, disclosure, timeliness, and relevance. For each maxim, we discuss what it means to obey, violate, and flout the maxim. We then extend this framework to the case of hybrid networks of humans and machines and consider its implications for the future of work. In particular, we consider the delegation of driving to autonomous vehicles and the delegation of news generation to bots.

CCS CONCEPTS

• **Human-centered computing** → **HCI theory, concepts and models**.

KEYWORDS

delegation, human–AI teaming, handoffs, pragmatics

1 INTRODUCTION

Current conversations about delegation of work in an organization — such as those of Venkataramani et al. (2021) on using network ties as a signal of reputation when deciding whether to delegate or of von Krogh (2018) on delegating work to A.I. technologies — consider modern problems of delegation in terms that would be recognizable to those using the word in the seventeenth century. Classically, a legate was a deputy tasked with delivering a message on behalf of a state or authority. In many cases, the legate was authorized to directly make decisions in response. The etymology of the word is derived from the Latin verb *legare*, meaning "to send"

and was brought into English in the 14th century in a religious context, later spreading to use in business and law (Oxford English Dictionary, 2020).

The concept of delegation is central to many disciplines. In diplomacy, such a person is called an envoy; all cultures have notions of diplomacy and representation (Lufti 2021; Mosley 1965). In business, such a person is an agent, acting on behalf of a principal; Adam Smith used the term in passing (1776) and there is a long tradition of studying delegation in industrial and organizational psychology (Solem, 1958; Leana, 1987). Books on management use the term loosely (Barnard 1968; Simon 2013), and modern economic theory uses it as part of game theory, specifically in principal-agent theory (Bendor et al., 2001). In law, delegates take the form of legal counsel appointed to zealously advocate on behalf of their client's interests (American Bar Association, 2006). In computer science, theories of delegation are mainly concerned with how to prompt machines to perform well-defined tasks (Castelfranchi & Falcone 1998).

Issues with the concept of delegation and its related theories exist and are amplified by progress in technology. New technologies can change the way delegation takes place. Consider, for example, how the industrial revolution was characterized by the advent of manufacturing automation, in which craft-related processes were eventually delegated to autonomous machines (Bainbridge, 1983). Artificial intelligence is distinct in that it can perform what are thought to be cognitive tasks, including decision making, discovery, and invention (Evans and Rzhetsky, 2010; Miroshnichenko, 2018). Moreover, the capabilities of AI systems change rapidly. This leads to new forms of delegation processes and new modes of failure for existing delegation processes. For example, a human might delegate driving to an autonomous driving system in weather situations the machine is not trained for; conversely, an autonomous driving system may rightly decide to delegate back to a human when weather conditions deteriorate, but hand over control too soon.

To develop a general theory of how delegation fails and what can be done to correct those failures, one must first understand what are the underlying assumptions of delegation. This manuscript articulates these assumptions, modeled on the way Grice articulated maxims related to coordination in the context of language. Delegation is related to coordination, but is a specific form of coordination that has its own presumptions, which we articulate here in the form of nine maxims of delegation derived from the social norms that underlie acts of delegating work.

2 LANGUAGE UNDERSTANDING AND THE PRAGMATICS OF DELEGATION

When people communicate using natural language, they do so with the understanding that both the speaker and listener have a shared framework for interpreting language. Pragmatics is concerned with

the context in which language is communicated and understood (Saygin and Cicekli 2002; Watzlawick et al. 2011). When a speaker communicates a thought, that communication is governed by certain norms that are assumed to be shared between the speaker and listener. More than simply being shared, these norms are assumed to be common knowledge, meaning that not only do both the speaker and listener know the norms, they also know that the other knows the norms, and so forth ad infinitum. Therefore, each can rely on the presumption of a shared understanding of the norms when deciding what to say and how to interpret what is said.

The norms that undergird natural language were codified by Paul Grice in what today are known as the four Gricean Maxims: the maxims of quantity, quality, relation, and manner. Each maxim concerns a particular assumption shared by listeners and speakers. The maxim of quantity relates to the shared assumption that a speaker's utterance is precisely as informative as necessary, no more or no less. The maxim of quality relates to the shared assumption that a speaker's utterance is believed to be true and reasonably supported by the evidence. The maxim of relation is concerned with being relevant. And the maxim of manner is concerned with stating things clearly and in a way that is interpretable.

Typically, the social norms of language are followed. However, a speaker may make an utterance that is contrary to the norms of language. If the speaker did so, the speaker is said to have violated the norm. Violation of the norms of language inhibits effective communication. For example, when a speaker asks a listener for the time by asking "Do you know what time it is?", the listener violates the norm of relevance by answering "Yes." However, it is possible to make an utterance that is contrary to the norms without violating them. In particular, the speaker can flout the norm, doing so deliberately for the purpose of communicating a particular message that goes beyond the literal acontextual meaning.

3 SOCIAL NORMS OF DELEGATION

When people delegate tasks to other people, they do so with the understanding that the agent, the person delegated to, and the principal, the person delegating, have a shared framework for interpreting requests to perform tasks in the social context in which the delegation occurs. The social norms of delegation dictate whether tasks can be delegated, who is permitted or required to delegate to whom, reporting requirements, and the manner in which tasks are carried out. For example, organizational structure often sets norms about who can delegate tasks to whom and the autonomy afforded to the agent carrying out the work, with downstream effects on task performance (Langfred & Moye, 2004). Social norms can guide inferences about matters as fundamental as whether a principal's message will be interpreted as an act of delegation at all. When Henry II of England asked "Will no one rid me of this meddlesome priest?" the social norms dictated that the listener would understand the king's question to be not a genuine inquiry but a command: rid the king of the meddlesome priest. This form of indirect speech act has been studied in both human–human (Searle, 1975) and human–machine (Briggs et al., 2017) communication and is often used when the delegated act is illicit because it gives the principal plausible deniability.

When the norms of delegation are obeyed, both the principal and agent can rely on their shared mental models of delegation to perform work efficiently and with little friction. When the norms of delegation are violated, the delegatory act fails and the principal or agent must recognize and correct the issue for the work to proceed intact. And when the norms are flouted by the principal or agent, it conveys a precise meaning to the other that is dictated by the context in which the flouting occurred.

4 HYBRID DELEGATION IN NETWORKS OF PEOPLE AND MACHINES

This work applies the framework of delegatory pragmatics to the emerging hybrid work processes that involve artificial intelligence and humans engaged in activities that are sometimes referred to as human-in-the-loop (Schirner et al. 2013) or algorithm-in-the-loop architectures (Green and Chen 2019). Sequences of delegation between agents of different types is a phenomenon linked to the growth of artificial intelligence and related technologies. Companies routinely delegate tasks such as translation, image recognition, and content moderation to computer-mediated crowdsourcing platforms; these platforms delegate to crowdworkers. Other examples involve people's interfaces with chatbots, which are assumed to run through artificial intelligence, though the conversational systems often have an escape mechanism that enlists humans. That is, companies delegate their customer service to bots, who, when stumped, delegate to humans. Many current chatbots used in industry are constructed as such hybrid systems with humans in the loop (Cranshaw et al. 2017; Kucherbaev et al. 2018; Toxtli et al. 2018). Machines are given the job of learning to classify, for example, images; the machines work off of labeled data, but enlist humans to create the labels or disambiguate hard cases (Cheng and Bernstein 2015; Quinn and Bederson 2011).

As machines take on vaguer and more complex tasks that require more sophisticated forms of intelligent behavior, problems with delegation immediately become apparent. While delegation to humans can be general and vague, delegation to machines has usually been very specific, restricted to the menu choices of an application. AI, and in particular, collections of humans and machines, may make it possible to ask machines to do things in the same general and vague way as humans can be asked through conversational interfaces (McTear et al. 2016). This may be useful because, with both humans and AI-capable machines in the loop, it may be possible to successfully manage more extemporaneous and complex organizations than can be built with either one alone. Experiments with complex crowd and team architectures suggest this as a productive path of investigation (Retelny et al. 2017; Zhou et al. 2018).

5 THE MAXIMS OF DELEGATING WORK

When people delegate tasks to other people, they do so with the understanding that the agent, the person delegated to, and the principal, the person delegating, have a shared framework for interpreting requests to perform tasks in the social context in which the delegation occurs. We introduce eight maxims of delegation dictated by this social context. The maxims of delegating work can be arranged into four broad categories: norms related to (1)

whether tasks can be delegated, (2) who is permitted or required to delegate to whom, and (3) requirements about reporting the results of completed tasks, and (4) the manner in which tasks are carried out — in brief, answering the questions whether, who, what, and how. We begin with two maxims related to whether or not tasks can be delegated:

Maxim of alienability. Do not delegate inalienable tasks; do not perform an inalienable task on behalf of someone else.

Maxim of feasibility. Do not delegate, nor accept responsibility for, tasks that you know to be impossible to complete, either in principle or because of private knowledge of the agent's capabilities.

Next, there are two maxims related to who is permitted or required to delegate to whom:

Maxim of authority. Delegate only those tasks that you have the authority to delegate and accept only those tasks that you have the authority to complete.

Maxim of responsibility. Do not perform a task directly when a delegate is better suited to complete it. Delegate tasks only to those with responsibility for their completion. Do not accept tasks for which one is not responsible.

Next, there are three maxims related to the way tasks are handed off and received:

Maxim of transparency (manner). When delegating a task, be forthright and ensure that the agent understands that a task has been handed off. When accepting a task that has been delegated, ensure that the agent, principal Iif the work deviates from a stated plan, or can no longer be performed, informs the principal. Ensure that the principal knows that the task is complete — or that the task cannot be completed.

Maxim of comprehensibility. Delegate in a way that the content of the request will be understood by the agent. In particular, it is helpful for the principal to spell out thespell the intention behind the task, so that in the event that details of the context change, similar variants of the task can still be performed. Conversely, from the agent's perspective, perform the task in such a way that the path taken to completion can be explained.

Maxim of disclosure. Provide all information known to be helpful for completing the task; request any information that will fill in known gaps in understanding. Conversely, agents should disclose substantial obstacles or uncertainties confronted in performing the task.

Finally, there are two maxims related to the manner in which tasks are carried out:

Maxim of timeliness. Tasks should be completed while they are appropriate to be completed. For example, dishes are to be done after the dinner, not days later.

Maxim of relevance. Tasks are assumed to be relevant to the current context. For example, the dishes to be done are the ones in the next room, not in a different home. Moreover, if the context shifts

substantially, the task may no longer remain relevant, and agent and principle may need to confer in order to adjust the task.

6 APPLICATIONS OF THE FRAMEWORK

Current managerial theories of delegation do not encompass the new kinds of delegation made possible with the introduction of autonomous AI agents that can themselves delegate tasks. The reasons are twofold. First, theories of delegation are rooted in human assumptions about the way that requests are communicated and understood, and machines generally do not understand these assumptions in the same way that humans do. Second, agents in a delegation relationship are generally assumed to have static or slowly changing capabilities as is clear from the assumptions built into principal–agent analysis; these assumptions do not necessarily hold when the agents are machines that learn. Conversely, current theories of delegation to machines do not encompass all of what we know about human behavior; this is important, because in complex situations, initiative changes back and forth between humans and machines (Horvitz 1999).

Here, we apply the framework of delegatory pragmatics to two cases of hybrid networks of humans and machines and consider its implications for the future of work, focusing on the contexts of delegation of driving tasks to autonomous vehicles and delegation of news generation to bots (Table 1).

6.1 Hybrid delegation in the context of autonomous vehicles

The 2004 DARPA Grand Challenge asked competitors to design an autonomous vehicle (AV) capable of navigating desert terrain and represented an early investment in technologies supporting the delegation of driving to machines (Thrun et al., 2006). The years that followed brought rapid progress in commercializing autonomous vehicle technologies for use in public transportation, freight transport, local delivery, and personal vehicles. Today, driverless taxi services are a burgeoning reality. The SAE J3016 framework delineates 6 levels of driving automation, ranging from momentary driver support features to fully autonomous systems to which the act of driving has been irrevocably delegated. The middlemost levels of driving automation feature the handoff of the driving task from human to machine and back. When individuals have delegated driving entirely to machine control by circumventing human fallback mechanisms, the result has sometimes been accidents (Dong et al., 2020). Central to the design debate on control mechanisms for autonomous vehicles are the pragmatics of handing off control from the human to machine and back; the proposed framework of delegatory pragmatics may offer useful guidance by delineating the shared expectations inherent in acts of delegation.

6.2 Hybrid delegation in the context of news production

Journalism is an old occupation, with evidence of news production going back thousands of years. Journalism as a profession has a simple hierarchy, with reporters reporting to editors reporting to owners. Editors delegate to reporters. More complex forms of technological delegation are now in play in modern journalism. Data journalists have programming as well as writing skills, and

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Table 1: Violations of Norms in Delegating Driving and Writing to Machines

Norm type	Norm	Driving violations	Writing violations
Whether	Alienability	It is possible to delegate driving to a machine, but sometimes it is not allowed or expected: for example, an Uber driver in a Tesla is not expected to use autopilot.	An editorial is generally inalienable: the words are supposed to be generated entirely by the author, whereas a synopsis of a television show is arguably alienable.
	Feasibility	Feasibility of delegation depends on context: it is more feasible for machines to drive on highways than on urban streets. Delegating urban driving during a hailstorm might be infeasible.	Delegating to the machine to write a summary of a story is more feasible than delegating the entirety of an investigative piece of journalism.
Who	Authority	The owner of a vehicle usually has the authority to delegate driving, but maybe not if engaged in driving for hire.	The writer usually has the authority to delegate, although there may be situations where the writer is not supposed to delegate: for example, when presenting an eyewitness account
	Responsibility	The owner may still have legal responsibility, although this responsibility might be shared by the AV's designers.	The writer as author will maintain responsibility for the text
What	Transparency	An AV violates transparency if it takes control under one set of conditions, and fails to hand back control when the context is outside of its ability to drive. Likewise, a human violates this by delegating a task unlikely to be intelligible to a machine, such as driving up onto a tow truck ramp.	A machine violates this norm if it realizes it can't generate intelligible text (perhaps it is not trained in the language or domain) and continues to attempt to do so. Humans violate this when they are not clear to the machine about what portion of the task is being delegated.
	Comprehensibility	The AV may not fully understand the intention of human drivers - for example, when risk taking is warranted. The AV may be unable to explain why it is rerouting.	Understanding the intention of a journalist - for example, to expose a corrupt scheme - may be difficult for a machine. The machine may have problems explaining what triggered a particular sentence, given its training may give it correlations but not causes.
	Disclosure	There may not be a simple way to disclose all driving considerations to the AV: it is a kind of frame problem. Likewise, the AV may not have a good way of explaining how it is balancing decisions on how fast to go and what turns to make.	Disclosing all that is behind a story to a machine may be difficult. Conversely, disclosing why decisions are being made on what to write about may be hard for the machine to make, as the ultimate cause may be a foundational model trained on millions of documents.
How	Timeliness	Driving delegation calls for instant action and reaction, so sluggish response would be a violation.	It may be OK for the machine to take its time on a story, but missing a deadline would be a violation.
	Relevance	An irrelevant response would involve driving at unreasonably slow speeds or along an unreasonably long path, making the journey longer than on alternative modes of transportation	An irrelevant response might be one that does not respond to the implicit presupposition of the delegation: for example, a short biography of an academic that focuses on commutes to work rather than publications.

combine these skills to analyze large tranches of data, including free form text, network data, and statistical data. When journalists use Python machine learning packages, they are delegating some of the inferential reading work that they might have done themselves to a machine. At the extreme, journalists are experimenting with text generation software, which formulates stories from statistics, thereby delegating not only the reading but the writing of a story. Doing so introduces problems related to transparency, alienability, and accountability that can be more fully understood in light of the proposed framework of delegatory pragmatics.

These ideas are summarized in a table listing norm violations for the two domains (Table 1).

CONCLUSION

We developed an integrative theory of the norms of delegating work within an organization inspired by pragmatics research studying the effect of context on interpretation of language. The theory centers around nine norms that we propose govern acts of delegation: the maxims of alienability, feasibility, authority, responsibility, transparency, comprehensibility, disclosure, timeliness, and relevance. The maxims form the basis of a shared understanding between the agent and principal about the expectations for task performance and provide a framework for understanding how delegation can go wrong. When these maxims are followed, delegation succeeds; when they are violated, delegation fails; and when they are flouted, inferences are drawn and implicated intentions are understood.

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