Pre-Analysis Plan for "AI, Organizations, and Tacit Knowledge"

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Introduction

Given recent advancements in artificial intelligence (AI) and machine-learning technology, there are increasing concerns that many of today's jobs will become automated and performed by robots or machines. The degree of such automation is unprecedented. A recent report by PWC (2017) estimates that nearly 40 percent of U.S. jobs will be impacted by automation within the next 15 years. In his best-selling book "AI Superpowers: China, Silicon Valley, and the New World Order", Kai-Fu Lee calculates that almost half of all current jobs will become automated. Understanding this labor market phenomena has important implications for firms, governments, and the public at large.

Much of this research has been grounded in a task-based approach introduced by Autor et al. (2003), which focuses primarily on job's technical suitability for automation. While the task-based approach focusing on technical capabilities represents an important first step, organizations are key drivers of technological change, and we must understand the role they will play in the future of work. In this paper, we propose one way to think about organizations in this debate. Grounded in the knowledge-based theory of firm (Kogut and Zander 1992), we theorize about the ways in which tacit versus explicit knowledge affects coordination and team performance, and how the introduction of AI onto a team impacts existing organizational routines. We posit that we can theorize of automation as the transfer of knowledge from an individual to a machine and argue that such transfer is more difficult when knowledge is tacit, so automation will be more difficult to implement for teams whose coordination is based on organizational routines rather than explicit mechanisms. We also test for complementarities between organizational knowledge, AI, and coordination ability. We describe our experimental approach in more details below.

Research design

Our study will be conducted using a randomized lab experiment at the Behavioral Research Lab at Columbia Business School. Groups of four participants will be randomized into different team arrangements to complete a coordination-based game. We describe each component in more details below.

Overview of the game

Participants will be put onto teams of four and play the minigame "Dash and Dine" on Super Mario Party on the Nintendo Switch. A video of the minigame can be found here: `https://www.youtube.com/watch?v=cz1eB-X6a2o`. In the game, teams of four have one minute to grab requested ingredients from tables to complete recipes for points. Each successful recipe is one point, and players must coordinate with the others on their team to complete the recipe. The game has several attractive properties for our purposes: (i) it is a coordination game where communication is required, (ii) outcome scores are easily collectable and displayed on the screen at all times, (iii) there is a built-in AI that can easily replace a player, and (iv) no prior experience with the gaming system is necessary for participants.

Teams will play for a total of 12 rounds, but the structure of the team will vary depending on whether the team is randomly assigned (i) to the tacit knowledge or explicit knowledge condition, and (ii) to the automation, new hire, or control conditions.

2x3 factorial design

Our experiment will follow a 2x3 factorial design. First, teams will be randomly assigned to either the tacit coordination condition or the explicit coordination condition. Second, teams will be randomly assigned to an organizational change. A third of teams will have a team-member replaced by an AI, a third will have a player replaced by a new player (the new hire condition), or a control condition. This treatment arm will allow us to test whether the e□ects we observe related to tacit-vs-explicit knowledge are unique to AI's or also occur when a new human player is introduced to the team. We may also turn this into a 2x5 factorial design by replacing the AI condition with three di□erent AI conditions depending on the strength of the AI: strong coordinating ability, medium coordinating ability, and week coordinating ability. Having three treatment arms for the automation condition allows us to test for complementarity between organizational elements, an important driver of firm organization and strategic decision making.

Coordination via tacit versus explicit knowledge

Our lab experiment will manipulate how knowledge is encoded on teams. Knowledge in organizations can be one of two types. Some knowledge in the firm is explicit, in that it is easy to identify and articulate. In the organizational context, such knowledge is usually codified, as in a firm having manuals, blueprints, or patents that explicitly describe the process in detail. Knowledge in the firm can also be tacit, in that it is di□cult to articulate and codify. Michael Polanyi (1966) remarked that "we can know more than we can tell", and this is indeed true within firms. For example, a team of employees may learn to coordinate their actions without any explicit agreement from the group to do so. Tacit knowledge is often encoded in organizational routines that are linked to organizational e□ciency. A rich literature in both evolutionary economics (Nelson and Winter 1982, 2002) and the behavioral theory of the firm (Cyert and March 1963) has discussed firms' use of routines to coordinate work. Both of these views theorized that routines helped performance by increasing coordination and decreasing communication costs (Becker and Zirpoli 2008). Since AI adoption involves making organizational explicit, it is natural to study how AI adoption interacts with how knowledge is encoded in the firm.

Our experiment will manipulate the use of routines by interfering with each team's ability to rely more on formal/explicit communication. The organizational learning literature has found that team routines depend on interactions between members that are both repeated and near-identical (Cohen and Bacdayan 1994; Gersick and Hackman 1990). For that reason, we manipulate the degree to which interactions between members are near-identical. We display our manipulation in Figure 1 below. While both teams have repeated interactions (playing the same game) with the members on their teams, the interactions between the tacit team are more identical across rounds— for each round, they play with the same team member (for example, player orange and player blue play together for the first 6 rounds in the tacit condition). Meanwhile, the teams in the explicit condition will alternate partners every round, which we predict will lead to less coordination via routines and increased coordination via verbal and explicit communication.

Organizational change

After the first six rounds, our experiment will randomly assign each team to one organizational change. A third of teams will have a team-member replaced by an AI, a third will have a player replaced by

Figure 1: Manipulation of tacit vs explicit knowledge

Figure 2: Manipulation of organizational change

a new player (the new hire condition), or a control condition. Figure 1 displays these organizational change manipulations.

Coordination ability of AI

We also plan to add in two additional treatment arms that manipulating the coordinating ability of the AI, as described above.

Structure

The structure of the experiment is displayed in Figure 3. In phase 1, each player will individually complete four mini games to measure their skills. Players will complete these games individually so that there are no spillover effects from other players (for example, performing better when assigned to a better competitor). In phase 2, teams will be randomly assigned to the tacit or explicit condition and play six rounds of the game. After phase 2, players complete a nine-item survey that measures tacit knowledge, trust, and effort. In phase 3, teams are randomly assigned to one of the organizational change conditions, play six rounds, and then complete a nine-item survey that measures trust, effort, and attitudes toward artificial intelligence.