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Improving collaboration in design thinking teams through automated coaches

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Abstract. Effective collaboration requires practice, reflection, and awareness of group dynamics. Expert coaches can facilitate learning these skills. However, while ideal, it is economically not feasible to have a coach for every team in every meeting. Emerging technology, such as sociometric badges, provide a promising opportunity to harness data about interactions to make collocated collaboration visible. These data can help researchers, designers, and users understand the complexity of collaboration and subsequently find means to improve them. This paper introduces a line of multidisciplinary research combining organisational science, business, and computer science. It aims to understand how communication patterns of design thinking teams in real world organizations are related to team performance, with the purpose of building automated coaches. The outcomes of this paper have potential applications in computer assisted coaching and contribute to the body of knowledge spanning multiple fields. It is hoped that the interdisciplinary nature of this research will promote the flow of ideas between social and computer sciences.

Introduction

Collaborating effectively requires practice and awareness of group dynamics. Teams can develop this beneficial collaborative interaction and thus improving team performance through close expert coaching. Though, while ideal, it may be unrealistic in practice to always have a coach closely supervising each team. An additional challenge is that teams require different information or coaching depending on the type of work they are doing, or the stage of a project they are in. In this line of research I introduce the idea of an automated coach that addresses this need to provide coaching and information given the current team activity.

Automated coaches are particularly applicable to collocated collaboration settings on face to face teamwork, which remains the dominant mode for solving complex problems despite the increase of virtual teams. It may be possible to apply my research to other verbal communication such as phones calls. This would require further investigation and is a promising avenue for future research. Furthermore, collocated collaboration provides unique benefits that are not easy to achieve in digitally mediated forms of group work (Olson et al., 2002). Literature suggests that face to face interaction can increase creativity (Gloor et al., 2014) and performance (Olguin et al., 2009).

Despite the potential benefits to practitioners and researchers alike, research into team dynamics has remained elusive due to its complexity and lack of quantitative measures. However, wearable electronic devices, such as sociometric badges (Sociometric Solutions, 2014), have made it affordable to collect detailed information on team communication. Initial studies indicate that these data can help to predict team outcomes with high accuracy (Parker et al., 2018). This deluge of detailed data unlocks new challenges and insights into collaboration. The analysis of data from sociometric badges enables the exploration of the potential of automated coaches, that can provide feedback on how to improve team performance based on a team's non-verbal communication behavior. I expect that automated coaches will enhance the preexisting benefits of face to face teamwork. This will enable teams to develop their communication and teamwork skill in situations which previously required an in-person coach.

Research Questions

This research aims to investigate the potential of automated coaches. This is done by analysing rich data streams collected through sociometric badges from new product development teams using design thinking in a real world environment. My research focuses on insights gained from investigating behavioural and verbal rotation in design thinking teams. This line of research is particularly interesting for design thinking teams because the process has distinct phases of group problem solving. Each of these phases has previously been shown to have different properties (Perry-Smith and Mannucci, 2017). Work mode will be used to differentiate interactions for different tasks within teams.

In order to develop the foundational technologies for automated coaches will be done in three stages of research and development. The first stage aims at understanding how and to what extent it is possible to detect team work mode based on sociometric signals. The second stage will revolve around identifying the relationship between team interaction and team performance for the different work modes. The final stage will focus on the design of interventions to improve team performance based on the results from the two earlier stages.

The specific research questions addressed in this line of research are:

- Can the design thinking mode of an individual in a team be predicted by the observed social signals of communication?
- How do the features extracted from social signals help in predicting individual work mode and team performance?
- Can interventions be designed to improve team performance based on the team mode and performance predictions?
- Can these interventions be implemented in an automated coach?

Findings To Date

To assess the research questions, data has been collected on four teams in a large consulting firm over a period of four weeks, using wearable sensors called sociometric badges (Pentland, 2010). Using this data I have answered my first research question with preliminary results indicating that design thinking mode can be predicted from these signals.

I used sci-kit learn to build models to predict design thinking stage. A variety of different models were trained on the 222 examples. Predictive models have F1 scores of up to 0.76, 0.71 and 0.68 for need finding, ideation, and prototyping respectively. The findings of this investigation complement those of earlier studies. My preliminary results advance prior research (Jayagopi et al., 2010) by increasing the number of work modes and demonstrating that they can be predicted outside of laboratory settings.

This is the first step in order to build an automated coach as to improve team performance, group members need to be presented with relevant information depending on their work mode.

Next Steps

While the research so far focused on demonstrating the feasibility of predicting work mode, the future contributions will be threefold. Firstly, the accuracy of predicting work mode will be improved through model refinement improvements. Secondly, the relationship between work mode, communication behavior and team performance will be studied, resulting in an overview of which type of interaction is related with improved team performance for the different work modes. Lastly,

investigating the potential of interventions through automated coaches will be the final step towards building automated coaches.

Future directions in terms of modeling include changing the threshold for positive labels and predicting on smaller windows of time. The positive labels for need finding, ideation, and prototyping are currently selected when participants report at least 50 percent of their time was spent in a given mode. Increasing this threshold may improve the ability to predict a given mode but will reduce the number of positive data points to classify. Future work could look at modeling the design thinking mode of entire teams, and study the mixture of modes within a team in relation to other outcomes, such as team performance.

Expected Contributions

This paper introduced the problems that need to be overcome in order to facilitate automated coaching in design thinking teams. This research is positioned within the literature covering both computer and social sciences. To the best of my knowledge there is no other line of research that enables automated coaching taking design thinking mode into account. This research also demonstrates the value that analysing team communication can provide. The predictions can be used directly for an automated coach as well as uncovering insights as to what makes team communication effective.

This will be the first study to predict design thinking modes and team performance from nonverbal behavior. The expected findings of this investigation are expected to complement those of earlier studies. As previously mentioned in the 'Findings To Date' section, our results will advance prior research by increasing the number of work modes predicted and showing they can be predicted outside the laboratory.

This work will offer valuable insights into the possibilities that automatically generated data offers towards team task classification. The expected outcomes have potential applications in computer assisted coaching and contribute to the body of knowledge spanning multiple fields.

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