

SOCIAL AUGMENTATION OF ENTERPRISE COMMUNICATION SYSTEMS FOR VIRTUAL TEAMS USING CHATBOTS

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Abstract. Innovative collaborative applications like Slack or Microsoft Teams have become an integral part of the working environment. The communication in teams, especially at work, is aggravated by socio-technical challenges which prohibit teams from reaching their optimal performance. This research addresses these problems and designs an enterprise communication system to actively support team interaction in order to increase team performance. Through social augmentation of the communication processes with chatbots this is achieved, leveraging cognitive-affective user states. First results of the system prototype evaluation are promising, showing an improvement of team cohesion and communication effectiveness induced through the design. Serving as indication, future steps are outlined guiding the research path for social augmentation of team communication.

Doctoral Research

“The whole is greater than the sum of its parts” (Aristotle)

Applications like Microsoft Teams and Slack have revolutionized the workplace by combining communicative, cooperative and coordinative functions into one application facilitating team work. A recent survey documented that 41%

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of users expect to use Microsoft Teams in 2020 (Finnegan, 2019a). These applications have also brought new constellations of teams to the workplace plugging in chatbots into the team communication which has not been realized before in applied work practice. Slack or Telegram provide a dedicated API to enable third party developers to add their own applications which can be used to boost team collaboration (Lebeuf, Storey, & Zagalsky, 2017). Slack for example supports a community of over 200.000 weekly active developers using their API (Finnegan, 2019b) showing the immense interest in this area. Research, on the other hand, is scarce on this area of chatbots in multi-user scenarios (Seering, Luria, Kaufman, & Hammer, in print).

Simultaneously, enterprise communication systems facilitate teams working together remotely connected from different cultural origins all around the globe. These teams, commonly labelled as virtual teams (Griffith, Sawyer, & Neale, 2003), are a major component of collaboration at the workplace and their functioning without obstacles is a core driver of productive enterprises. The famous quote above of the ancient Greek philosopher Aristotle paraphrases well the promise of effective teams. Google has also identified their importance and therefore started “Project Aristotle”. The study exploring factors of team effectiveness, following the quote above, confirmed the assumptions about teams and identified important factors as shared social norms and the ability of team members to recognize emotions of others (Camarote, 2019; Google, 2017).|

|Nevertheless, enterprise collaboration still faces great challenges and especially remote communication is one of the major breakpoints for teams to be productive. Communication serves specific informative and coordinative team needs, typically, it takes place through instant-messaging, telephone or video conferencing. These media support multi-tasking and generate interruptions (Li & Gupta, 2009), which produces stress and negative emotional wellbeing (Kushlev & Dunn, 2015). Further, it aggravates the attention (Gutwin, Bateman, Arora, & Coveney, 2017) and in succession participation in the meeting. In its structure these media show a low ability of transferring social signals and cues (Kuber & Wright, 2013), which differentiates it from face to face meetings and is one of the main sources of these challenges. In consequence, they influence the team in its development. As the core process in working virtual teams is hindered, they cannot develop their strength and productivity. Finally, the team effectiveness and performance is impaired (Powell, Piccoli, & Ives, 2004).

This research will design a system which is supporting actively communicative processes in the working environment. The system shall increase team performance and master communicative challenges through the application of matured technologies of text- and speech-based chatbots, the detection of user states and selective transmission of social signals. This research is conducted as an artifact-centric approach by designing social augmentation in an enterprise communication system for virtual teams. I pick up on social augmentation defined

as “supporting users during social interaction” (Damian & André, 2018) and focus specifically on the context of team communication. The work shall be realized through a design science research project (DSR) in two cycles. The following overall research question shall be pursued:

How to design an enterprise communication system for virtual teams using social augmentation chatbots to overcome the challenges in virtual team communication at the workplace in order to increase team efficiency and effectiveness?

To answer this question this research aims at providing a social augmentation of virtual team communication using chatbots. Based on the theory of media synchronicity (Dennis, Fuller, & Valacich, 2008) and team process models (Ilgen, Hollenbeck, Johnson, & Jundt, 2005; Marks, Mathieu, & Zaccaro, 2001) social augmentation shall be accomplished to provide a richer virtual team communication resulting in better team performance. The cycles are further built upon the theoretical work of social signal processing (Pentland, 2007; Vinciarelli, Pantic, & Boulard, 2009), feedback intervention theory (Kluger & DeNisi, 1996), and the computers are social actors paradigm (Nass, Steuer, & Tauber, 1994). It is known that both cognitive and affective user states play an important role in communication and are closely related factors for the mentioned challenges (Kelly & Barsade, 2001; Oatley & Johnson-Laird, 1987). Increased arousal and stress are expressions of affective states, as well as attention is for cognitive states. These shall be targeted with the system design, exemplary visualized through a prototype in figure 1 including a legend about its main components.

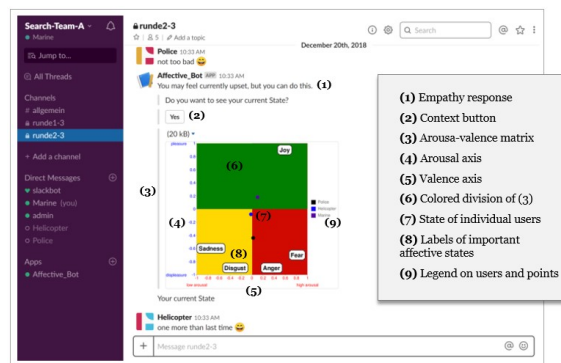


Figure 1. System prototype design in Slack.

First, a chatbot will be developed which is plugged into the virtual team communication. The usage of chatbots in teams as fully fledged team member shall support the team character and equipped with abilities and functionalities it can support the team. Some studies have started to investigate its application in collaborative context with auspicious results (e.g. Derrick, Read, Nguyen, Callens, & De Vreede, 2013; Tegos, Demetriadis, & Karakostas, 2011). Leveraging chatbots as foundation is providing the innovative and accelerating

aspect for the system. Second, a feedback functionality shall be designed to increase emotional and cognitive awareness of the individuals and the team (Algesheimer, Dholakia, & Gurău, 2011) employing chatbots as objective team members. Further, team cohesion can be strengthened with this approach which supports team performance. This has already been investigated in a first experimental study (Benke, Ruoff, & Maedche, currently under review). Last, the channel of communication, e.g. IM, shall be extended based on affective and cognitive user states. Usually limited in medium's transmitting capacity the team members reveal problems in expressing themselves and transporting information, a condition for successful teams, especially for affective information. According to the mentioned study by Google members of successful teams had a high ability to read emotions of the others based on facial expressions (Camarote, 2019; Google, 2017). Using the social signal processing paradigm this research aims to help the system understand the users' states better and provide additional information based on this. Through a team member a chatbot may be, this information will be transferred more efficient and thereby improving communication effectiveness and team performance.

Findings & Next Steps

This research focuses on the social augmentation of virtual team communication using chatbots. Based on the theory of communication (Shannon & Weaver, 1949) which is embedded in the theory of media synchronicity I apply a package of three components to expand the communication medium. Through this, I design an extension of the medium by integrating user states which have been excluded from considerations before. This enables the medium to become more user-sensitive and flexible on the team communication demands.

My research is now in the process of further develop the system design and investigating it through empirical studies. First, a systematic literature review has been conducted giving an overview about collaboration technologies and their investigation upon user states in the dedicated body of literature. Additionally, a study on designing chatbots in team conversations has been published investigating chatbot design features. Results show that the chatbot design should balance both functionalities and human-like design features to achieve the best possible usefulness and ease-of-use (Rietz, Benke, & Maedche, 2019). This serves as the foundation of the following design cycles. In a second study I designed and developed a chatbot, which was plugged into virtual team communication and provided the users with feedback on their affective state. A design for presenting the feedback was derived in a pretest and the system was evaluated in an empirical experiment (see fig. 1 for the design). The results are promising as it could be shown that team cohesion and communication effectiveness was increased significantly under the treatment condition. Also individual satisfaction

was augmented significantly through the system. Both the latter ones are seen as predecessors of team performance. Though significant effects on this construct could not be observed, it indicates a positive implication for the overall dependent variable of this research.

In the future two further experimental series are planned. Firstly, a further developed and refined artefact shall be evaluated in a large field experiment on its effect on the team processes and performance. This finalizes the first design cycle of the DSR project. Secondly, the system will be expanded and evaluated focusing on the transfer of missing social signals like attention. Here as well, the goal is to conduct a large field study. This concludes the second and final cycle of the DSR project.

Expected Contribution

With this research I expect to make three theoretical and several practical contributions. On the theoretical side as main contribution, prescriptive knowledge will be acquired by designing a system for social augmentation of team communication using chatbots. Through the design principles derived in the two cycles in combination with their evaluation, concrete design knowledge of how to build such a system in detail will be generated. By doing so, a starting point of a new theory of design and action (Gregor, 2006) will be established. Through this design, the kernel theories can be tested under unexperienced context conditions. As context matters in theorizing the application of these theories have to be investigated for the combination of new scenarios and technologies like chatbots in teams. Besides prescriptive knowledge, also descriptive knowledge will be acquired as the underlying theory of media synchronicity will be extended with the implication of moderating factors as application of user states, in teams and team constellations with chatbots. On the practical side, team managers and team members as users will experience higher virtual team performance and benefit from the system when collaborating. This may have major influence on the enterprise productivity. System designers and developers receive guidance through a resulting prescriptive knowledge on how to socially augment communication systems. Finally, the results will enable better virtual team work and possibly make a small contribution to the ambitious goal of creating a better future of work.

References

- Algesheimer, R., Dholakia, U. M., & Gurău, C. (2011). Virtual team performance in a highly competitive environment. *Group and Organization Management*, 36(2), 161–190. <https://doi.org/10.1177/1059601110391251>
- Benke, I., Ruoff, M., & Maedche, A. (under review). TeamEmo: An Affective

- Feedback System for Virtual Team Communication using Chatbots. In *Proceedings of the ACM 2020 International Conference on Supporting Group Work - GROUP '20*.
- Camarote, R. (2019). What Google's New Emotional Intelligence Study Says About Teamwork and Success. *INC*. Retrieved from <https://www.inc.com/robin-camarote/google-study-reveals-emotional-intelligence-on-teams-determines-success.html?cid=search>
- Damian, I., & André, E. (2018). Designing systems to augment social interactions. *IEEE Pervasive Computing*, *17*(1), 99–103. <https://doi.org/10.1109/MPRV.2018.011591068>
- Dennis, A. R., Fuller, R. M., & Valacich, J. S. (2008). Media , tasks , and communication processes : a theory of media synchronicity. *Management Information Systems Quarterly*, *32*(3), 575–600.
- Derrick, D. C., Read, A., Nguyen, C., Callens, A., & De Vreede, G. J. (2013). Automated group facilitation for gathering wide audience end-user requirements. *Proceedings of the Annual Hawaii International Conference on System Sciences*, 195–204. <https://doi.org/10.1109/HICSS.2013.109>
- Finnegan, M. (2019a). Collaboration 2019: Teams, Slack and what's coming. *Computerworld.com*. Retrieved from <https://www.computerworld.com/article/3329540/collaboration-2019-teams-slack-and-whats-coming.html>
- Finnegan, M. (2019b). Slack targets developers with Block Kit UI framework. *Computerworld.com*. Retrieved from <https://www.computerworld.com/article/3341387/slack-targets-developers-with-block-kit-ui-framework.html>
- Google. (2017). re:Work Guide: Understand team effectiveness. Retrieved from <https://rework.withgoogle.com/blog/how-google-thinks-team-effectiveness/>
- Gregor, S. (2006). The Nature of Theory in Information Systems. *Management Information Systems Quarterly*, *30*(3), 611–642.
- Griffith, Sawyer, & Neale. (2003). Virtualness and Knowledge in Teams: Managing the Love Triangle of Organizations, Individuals, and Information Technology. *Management Information Systems Quarterly*, *27*(2), 265. <https://doi.org/10.2307/30036531>
- Gutwin, C., Bateman, S., Arora, G., & Coveney, A. (2017). Looking Away and Catching Up: Dealing with Brief Attentional Disconnection in Synchronous Groupware. In *Proceedings of the 2017 ACM Conference on Computer Supported Cooperative Work and Social Computing - CSCW '17* (pp. 2221–2235). <https://doi.org/10.1145/2998181.2998226>
- Ilgen, D. R., Hollenbeck, J. R., Johnson, M., & Jundt, D. (2005). Teams in Organizations: From Input-Process-Output Models to IMO Models. *Annual Review of Psychology*, *56*(1), 517–543. <https://doi.org/10.1146/annurev.psych.56.091103.070250>
- Kelly, J. R., & Barsade, S. G. (2001). Mood and emotions in small groups and work teams. *Organizational Behavior and Human Decision Processes*, *86*(1), 99–130. <https://doi.org/10.1006/obhd.2001.2974>
- Kluger, A., & DeNisi, A. (1996). The Effects of Feedback Interventions on Performance: A Historical Review, a Meta-Analysis, and a Preliminary Feedback Intervention Theory. *Psychological Bulletin*, *119*(2), 254–284. <https://doi.org/10.1037//0033-2909.119.2.254>
- Kuber, R., & Wright, F. P. (2013). Augmenting the Instant Messaging Experience Through the Use of Brain-Computer Interface and Gestural Technologies. *International Journal of Human-Computer Interaction*, *29*(3), 178–191. <https://doi.org/10.1080/10447318.2012.702635>

- Kushlev, K., & Dunn, E. W. (2015). Checking email less frequently reduces stress. *Computers in Human Behavior*, *43*, 220–228. <https://doi.org/10.1016/j.chb.2014.11.005>
- Lebeuf, C., Storey, M.-A., & Zagalsky, A. (2017). How Software Developers Mitigate Collaboration Friction with Chatbots. Retrieved from <http://arxiv.org/abs/1702.07011>
- Li, H., & Gupta, A. (2009). Understanding the Impact of Instant Messaging (IM) on Subjective Task Complexity and User Satisfaction. *PACIS 2009 Proceedings*.
- Marks, M. A., Mathieu, J. E., & Zaccaro, S. (2001). A Temporally Based Framework and Taxonomy of Team Processes. *Academy of Management Review*, *26*(3), 356–376. <https://doi.org/10.5465/AMR.2001.4845785>
- Nass, C., Steuer, J., & Tauber, E. R. (1994). Computers are social actors. In *Proceedings of the 2019 CHI Conference on Human Factors in Computing Systems - CHI '19* (pp. 72–78). <https://doi.org/10.1145/259963.260288>
- Oatley, K., & Johnson-Laird, P. N. (1987). Towards a Cognitive Theory of Emotions. *Cognition and Emotion*, *1*(1), 29–50. <https://doi.org/10.1080/02699938708408362>
- Pentland, A. (2007). On the Collective Nature of Human Intelligence. *Adaptive Behavior*, *15*(2), 189–198. <https://doi.org/10.1177/1059712307078653>
- Powell, A., Piccoli, G., & Ives, B. (2004). Virtual teams: A Review of Current Literature and Directions for Future Research. *ACM SIGMIS Database*, *35*(1), 6–36. <https://doi.org/10.1145/968464.968467>
- Rietz, T., Benke, I., & Maedche, A. (2019). The Impact of Anthropomorphic and Functional Chatbot Design Features in Enterprise Collaboration Systems on User Acceptance. In *Proceedings of the 14th International Conference on Wirtschaftsinformatik*.
- Seering, J., Luria, M., Kaufman, G., & Hammer, J. (n.d.). Beyond Dyadic Interactions : Considering Chatbots as Community Members. *Proceedings of the 2019 CHI Conference on Human Factors in Computing Systems - CHI '19*.
- Shannon, C., & Weaver, W. (1949). *The Mathematical Theory of Communication*. Urbana: University of Illinois Press.
- Tegos, S., Demetriadis, S., & Karakostas, A. (2011). MentorChat: Introducing a configurable conversational agent as a tool for adaptive online collaboration support. *Proceedings - 2011 Panhellenic Conference on Informatics, PCI 2011*, 13–17. <https://doi.org/10.1109/PCI.2011.24>
- Vinciarelli, A., Pantic, M., & Bourlard, H. (2009). Social Signal Processing: Survey of an emerging domain. *Image and Vision Computing*, *1*.