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# Understanding the Dynamic Nature of Contribution in Virtual Project Teams

(Research-in-Progress)

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## ABSTRACT

Two dysfunctional contribution behaviors in virtual project teams are non-contribution (e.g., social loafing, free riding, and shirking) and over-contribution (e.g., being a lone wolf or a “diligent isolate”). To prevent these behaviors or mitigate them when they occur, some coping actions (e.g., increasing contribution visibility) can be undertaken. In this research-in-progress, we report on the findings of a pilot study run to increase our understanding of the dynamic nature of such dysfunctional contribution behaviors and coping actions. We also briefly explain our plans for the main study.

## INTRODUCTION

In today’s digital era, most project teams rely on information technologies (IT) to collaborate and thus are somewhat virtualized (Furst et al. 2004) even when collocated (Morley et al. 2015). Virtual project teams use IT for a variety of purposes, including knowledge coordination (Malhotra and Majchrzak 2012), collaborative programming (Bravo et al. 2013), and collaborative project planning (Pérez-Mateo-Subirá et al. 2014). Such teams sometimes suffer from dysfunctional contribution behaviors (Pieterse and Thompson 2010), particularly non-contribution or over-contribution. Non-contribution is manifested in specific behaviors such as social loafing and free riding (Kidwell and Bennett 1993). Over-contribution is often exhibited as dominance (Kao 2013), being a lone wolf (Barr et al. 2005), or being a “diligent isolate” (Pieterse and Thompson 2010). These issues are not only relevant for real-world projects but also raise pedagogical issues when using group activities, especially in project management education.

Our review of these dysfunctional contribution behaviors across the literature on virtual teams, project management, and education revealed two research streams. In the first stream, researchers have focused on conceptualizing these behaviors and examining their influence on team performance (Karau and Williams 1993; Kidwell and Bennett 1993). For example, the meta-analysis by Karau and Williams (1993) identifies key antecedents of social loafing, including expectations of co-worker performance. In the second stream, researchers have sought coping actions that can prevent dysfunctional contribution behaviors or mitigate them when they occur (Pieterse and Thompson 2010). For instance, increasing the visibility of effort—or lack therefore—by using technology (e.g., Wikis) is an effective action to prevent social loafing (Khandaker and Soh 2010).

A closer examination of these two streams suggests that the dysfunctional contribution behaviors and the effect of coping actions on them are chiefly treated as static phenomena and are examined using cross-sectional research designs. However, researchers have recently emphasized the dynamic nature of contribution behaviors (Geister et al. 2006) and have called for more longitudinal studies of this dynamic (Gilson et al. 2015). Given the scarcity of such research and its implications for managing project teams, we aim in this study to advance our understanding of the dynamics of dysfunctional contribution behaviors and the effects of coping actions. In particular, by adopting a longitudinal perspective, we look to identifying some patterns of dynamic contribution behaviors thus enriching the categorical view of non-contributor/contributor/over-contributor by considering the role of time. We also intend to identify some patterns of the dynamic effects of coping actions, complementing the binary view of effective/ineffective actions.

In this research-in-progress, we are reporting on a pilot phase in which we studied 29 teams of undergraduate students for three months. Each team used an online collaboration environment to plan a project. The first author took several coping actions regarding dysfunctional contribution behaviors in these teams and collected longitudinal

data on team members' contribution behaviors. We made sense of this data using a combination of big-data visualization tools and coding techniques of qualitative research, searching for emergent patterns.

Our preliminary analysis of the pilot data suggests that we can make two contributions. First, we will contribute to the literature on virtual project teams by further demonstrating that dysfunctional contribution behaviors and the effects of coping actions are highly dynamic. We offer several dynamic patterns of dysfunctional contribution behaviors (e.g., a free rider becoming a contributor over time) as well as dynamic patterns of the effects of coping actions (e.g., short- vs. long-term effect). Second, we will contribute to the literature on project management education by showcasing how an online collaboration environment in addition to the use of peer assessment discourages students from being free riders or lone wolves.

In the IRWITPM, we hope to receive feedback on how to proceed with the main phase of this study next year and also on how to make a stronger theoretical contribution. Currently, we plan to monitor more teams, collect richer and more structured data, and enact more formal coping actions.

In the following section, we discuss in more depth the notions of virtual project teams, dysfunctional contribution behaviors, and coping actions.

## CONCEPTUAL BACKGROUND

### The Virtuality of Project Teams

A project refers to “a temporary endeavor undertaken to create a unique product, service, or result” (The PMBOK® Guide 2013, p. 416). Project teams exhibit varying degrees of virtuality. Some project teams are completely virtual, where “two or more persons who work together on a mutual goal or work assignment, interact from different locations, and therefore communicate and cooperate by means of information and communication technology” (Geister et al. 2006, pp. 459-460). Some other teams are partially virtual, as “collocated, face-to-face teams can also exhibit high levels of virtuality” (Morley et al. 2015, p. 189) because of the proliferating use of technology. Whether complete or partial, virtuality is a key feature of today's project teams because “Advances in technology facilitate communication, and the sharing of information among team members” (Morley et al. 2015).

### Dysfunctional Contribution Behaviors

Many virtual project teams suffer from dysfunctional contribution behaviors such as non-contribution or over-contribution. Non-contribution behaviors have been studied for at least 100 years using concepts such as social loafing and free riding (Simms and Nichols 2014) and shirking (Kidwell and Bennett 1993). First, social loafing refers to “the tendency for individuals to expend less effort when working collectively than when working individually” (Karau and Williams 1993, p. 681). Second, in free riding, non-contributing individuals opportunistically aim to get the same benefits as those who actually make an effort. For example, free riding occurs in education “when one or more students in the group does little or no work, thereby contributing almost nothing to the wellbeing of the group, and consequently decreasing the group's ability to perform to their potential” (Roberts and McInnerney 2007, p. 261). Free riders “don't want to do the work but get the same grade as everyone else” (Ekblaw 2016, p. 123). Third, in shirking, a person is not willing to contribute and ignores his or her responsibility to make an effort. Despite the conceptual differences of these three specific behaviors, “a common thread underlies them, that is, propensity to withhold effort” (Kidwell and Bennett 1993, p. 429). Withholding effort is a threat to team performance. A noncontributing member does not add to team outcome, but also—as the “sucker effect” (Schnake 1991) explains—becomes a demotivation for other team members to do their work.

A less studied dysfunctional contribution behavior is over-contribution, which is referred to as being a lone wolf (Barr et al. 2005) or a diligent isolate (Pieterse and Thompson 2010). A lone wolf refers to an individual who has “a preference to work alone, a dislike of group process and the ideas of others, and a proclivity to see others as less capable and effective” (Barr et al. 2005). Likewise, a diligent isolate refers to “an individual who increases his or her effort and willingly works alone, not only to complete his or her own tasks, but also, in an effort to ‘save the project’, on the tasks of other members” (Pieterse and Thompson 2010, p. 357). Whether a lone wolf or a diligent isolate, over-contributors tend to trespass over the responsibility boundaries of other team members. Like non-contribution, over-contribution is a threat to team performance, as the existence of such individuals demotivates other members to contribute and obstructs synergy.

### Coping Actions against Dysfunctional Contribution Behaviors

In order to prevent such dysfunctional contribution behaviors or to reduce them when they occur, different coping actions have been presented in the literature. Here we will discuss key actions relevant to managing virtual project teams.

**Increasing Visibility:** In virtual project teams, the lack of visibility of individual member contributions (Kuruppuarachchi 2009) makes it difficult to uncover dysfunctional behaviors in a timely fashion. To cope with this issue, contribution can be made visible in subjective and objective ways. In a subjective way, peer evaluations such as 360-degree feedback can be used (Shipper et al. 2007). In a more objective way, IT can be used to track individual contributions in collaborative environments. For example, in the context of collaborative writing, using Wikis (Khandaker and Soh 2010; Meishar-Tal and Gorsky 2010) and Google Docs (Wang et al. 2015) helps to make individual contributions visible as these technologies preserve a history of every change made.

**Linking Pay to Performance:** To prevent non-contribution, one's share of the gains can be linked to performance (Rynes et al. 2004). While the teamwork is ongoing, the extent of contribution can be used as developmental (formative) feedback to warn team members that they will lose their share of the benefits if they do not change their dysfunctional contribution behaviors. After the teamwork is finished, the extent of contribution can be used in an evaluative fashion to ensure that each member's share of team outcomes is proportional to his or her effort.

**Designing Teams for Contribution:** When possible, a proper work breakdown and role assignment determines who should do what. Thus, if a specific work package assigned to an individual is not done, her non-contribution becomes visible. Moreover, controlling team size decreases the chances of free riding (He 2012) because it increases the visibility of the efforts of each individual. Also, setting precise deadlines for each piece of the work has been shown to increase motivation for dedicating effort.

**Building Team Morale:** In project management, building team morale is found to decrease free riding behavior (He 2012). In virtual project teams, occasional face-to-face meetings as well as running team-building activities—especially early in a project—improve the sense of being a team and thus add to individuals' motivation to contribute.

### Towards Understanding the Dynamics of Contribution

In the literature, most studies have treated dysfunctional contribution behaviors and the effects of coping actions as static phenomena. Nevertheless, this provides only a partial understanding of the nature of contribution as an individual who is not contributing at one point might contribute later on (e.g., procrastinators), or an over-contributor might cease to contribute. Likewise, the enacted coping actions might have dynamic effects. For example, Geister et al. (2006) found that team process feedback can increase motivation and performance of virtual teams over time.

. To enable the study of such dynamics, we developed a conceptual framework (Figure 1). This framework suggests that individual contribution behaviors will not remain the same over time. Before the collaboration begins, managers overseeing the teamwork might initially take coping actions to prevent dysfunctional behaviors. Then, over time, several corrective or preventive actions could be undertaken to change contribution behaviors.

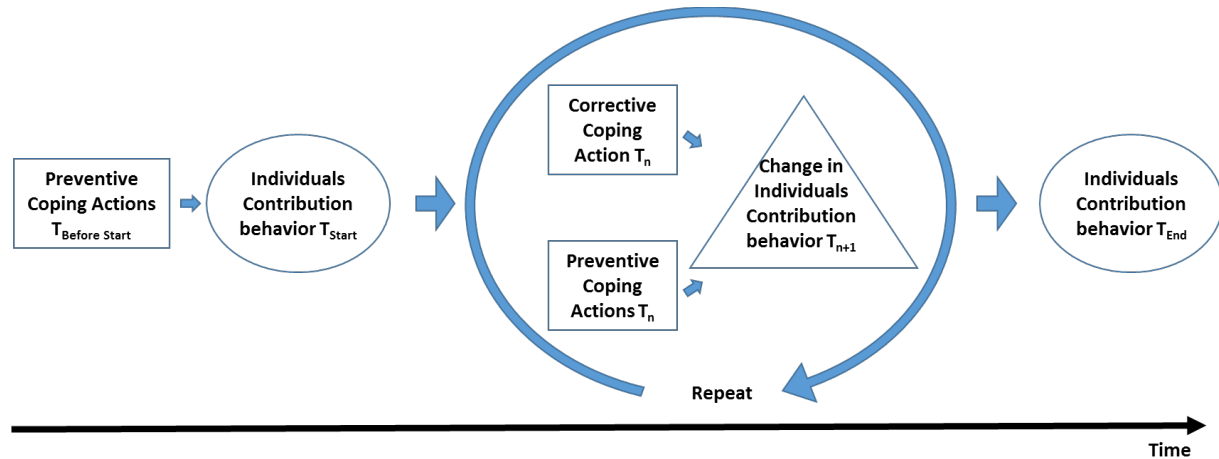


Figure 1 – Our Conceptual Framework

## PILOT STUDY

### Research Methods

To gain an initial understanding of the dynamics of contribution behavior and the effects of coping actions, we ran a pilot study. We studied 29 teams of 4 or 5 undergraduate students enrolled in an introductory project management course at a university in the UK. Each team worked together for about 3 months to develop a project plan worth 100% of their course mark. The students were asked to write collaboratively on Google Docs, an online in-browser word processor (see Wang et al. 2015). Google Docs was chosen over Wikis because it provides an easy-to-use interface similar to MS Word and thus does not require user training.

The contribution of individual students was assessed in two ways. First, in a rather objective way, the revision history of Google Docs was used. The revision history tracks who has written or edited what over time at the character level. To make sense of this data, a big data visualization tool called DocuViz (Wang et al. 2015) was used and the contribution behaviors in each team were summarized in one graph. Second, in a more subjective way, two rounds of peer evaluation were administered. The first round was an adaptation of 360-degree performance evaluation and was carried out using an online survey. The students were encouraged to provide comments justifying their evaluations as well as offering ways to get a better evaluation score next time. The second round of peer evaluation was a simple form whereby teams should collectively agree on each member's contribution to the submitted project plan.

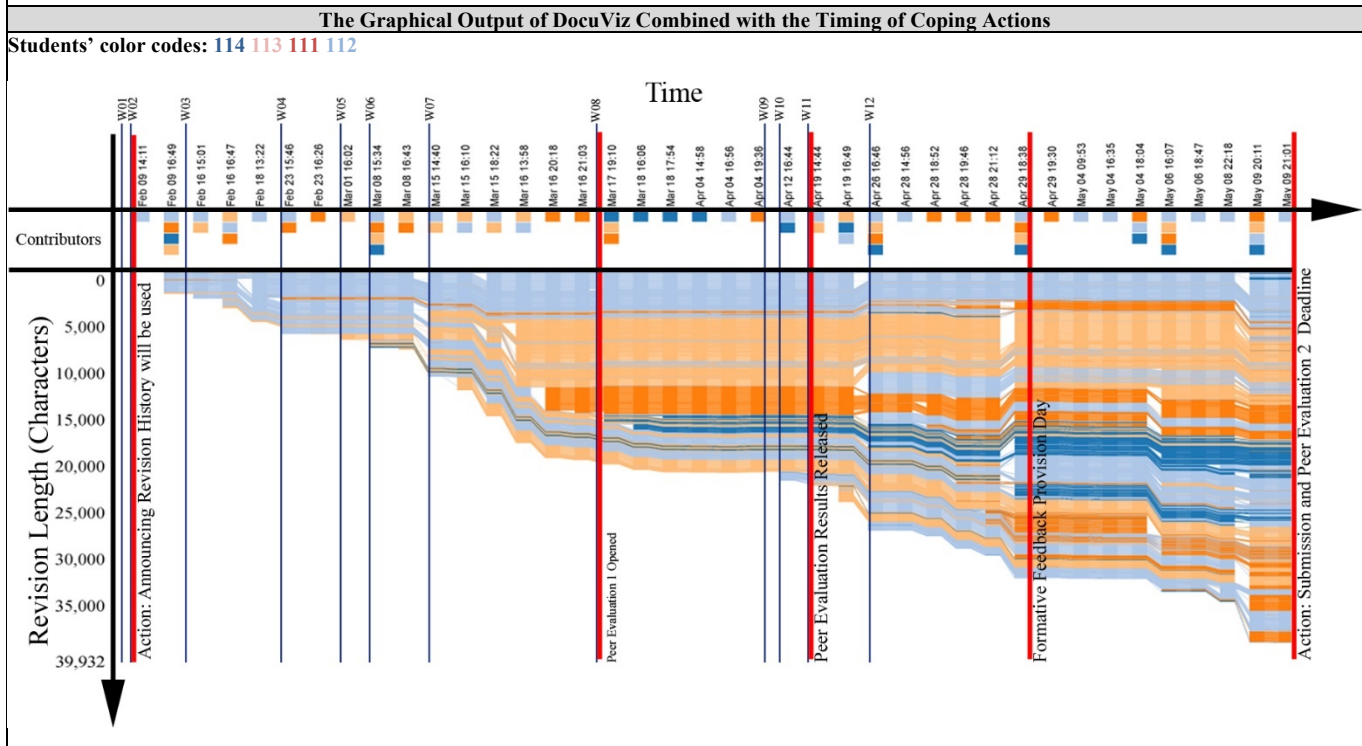
Moreover, over the course of three months (12 weeks of teaching), the first author (who was teaching the course) carried out several coping actions. First, before the start of the course, the project planning steps were broken down into 30 smaller "Project Chunks." Each week, the students started to complete 2 or 3 project chunks face-to-face; yet they had to continue to collaborate in team meetings and virtually after class to finish the started chunks. During the term, the first author interacted with each group in each session to ensure the weekly project chunks were being started. Second, in the second week of the course, Google Docs was introduced to the students; and the students were made aware that the contribution history of Google Docs would be used to assess their contribution. Third, peer evaluations were announced upfront in the course, and each one was emphasized a week before it was done. The students were encouraged to evaluate each other as honestly and accurately as possible. Each student anonymously rated and commented on how each teammate could improve his or her contribution. The results of the first round of peer evaluations were privately provided to all the students so that they could read the anonymous comments from their teammates. For the second peer evaluation, the students in each team had to agree on the contribution percentage of each team member and had to submit one peer assessment form as a team along with their project plan. Fourth, a formative feedback deadline by which the students should have completed a draft of their project plans was determined and announced. Formative feedback was provided as constructive comments on their project plans, without grading the plans.

Using the collected data, a mini case for each team was built. Table 1 shows the mini case data for Team 20. The top part of the table presents the data visualization generated by DocuViz, illustrating how the project plan document grew from zero characters to 39,932. In the graph, the horizontal axis is the time, increasing from left to right. The

vertical axis represents the character composition of the text, increasing from top to bottom. The colors indicate who wrote each block of the text. Over time, a block of text might move in the vertical position in the graph as people write text before it in the document. It might also shrink, grow, or disappear as it is edited. On average, a completed project plan comprised approximately 35,000 characters. The mini case data also comprises some information about the enacted coping actions. First, in the data visualization graph (see Table 1), the timing of the coping actions is indicated by bold red lines. The bottom part of the table reports on the results of the two peer evaluation surveys. The first evaluation contains textual developmental comments and a numeric evaluation of contribution. The table also indicates the team's level of disagreement on each individual's contribution (the variance of contribution scores for each individual). The second peer evaluation contains a numeric contribution score assigned to each individual by the team.

In our data analysis, we used NVivo 10 to code the data. We coded regions in the graph and the text in the evaluations.

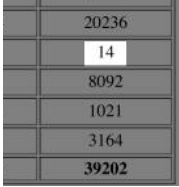


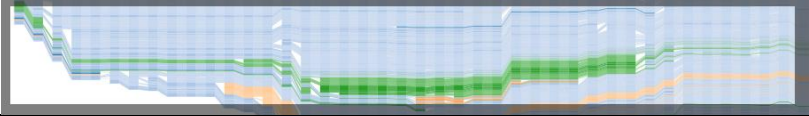
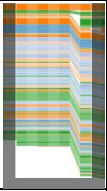
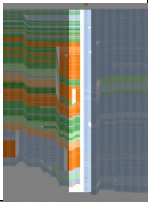
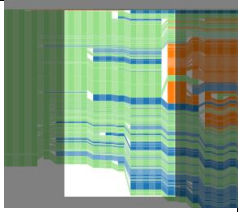
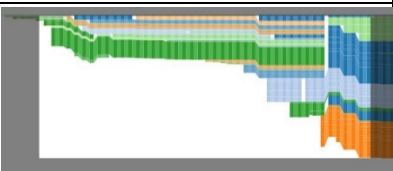
Table 1 – Team 20 Mini Case Data



Student	Peer Evaluation 1			Teammates' Comments (Not Mandatory)	Peer Evaluation 2	Objective Contribution to Project Plan (Generated by DocuViz)			
	Contribution Mean (max 10)	Team's Disagreement	Self-rating of Contribution		Contribution (Max 100%)	Edit of Self	Edit of Others	Total Edits	Contribution to Final Document
112	9.5	0.5	8	<ul style="list-style-type: none"> <li>Contributed fully</li> </ul>	100%	57,906	13,240	71,146	17,338
113	3.7	0.3	-	<ul style="list-style-type: none"> <li>Missing from presentation, copy &amp; pasted work directly from report.</li> <li>[The member] was not present for the presentation and did not contribute that much to the [PowerPoint]</li> <li>missed the presentation as well as organised group meetings but has contributed by suggesting some good ideas</li> </ul>	92%	55,620	10,176	65,796	9,477
114	9	0	10	<ul style="list-style-type: none"> <li>Equal contribution with [others]</li> </ul>	92%	16,534	3,616	20,150	4,043
111	9	2	9	<ul style="list-style-type: none"> <li>Communicated clearly and always attended meetings</li> <li>Equal contribution with [others]</li> </ul>	100%	37,535	13,230	50,765	9,070
<b>Total Edits</b>						<b>167,595</b>	<b>40,263</b>	<b>207,858</b>	<b>39,929</b>

**Findings**

By looking for non-contribution and over-contribution behaviors over time, we could identify 8 dynamic behavior archetypes, which are summarized in Table 2. In particular, we noticed some cases in which free riders and contributors changing their behavior over time.

Table 2 – Dynamic Archetypes of Contribution Behaviors		
Behavioral Archetype	Count Teams	Sample Codes
1- A free rider constantly avoids contributing.	4	<p>Team 26 – Student 141 has contributed 14 characters out of 39,202 characters in a document. In the first peer evaluation, team members commented: “[...] <i>Could improve by putting more time into the project and completing the parts in the main document - have given this member a 10 as I am confident they will complete the needed sections by the due date and verbal contribution has been extremely valuable.</i>”</p> 
2- A free rider makes a useless contribution.	10	<p>Team 01 – In the highlighted region, a part of the document written by a free riding member (indicated in orange) is later removed from the document.</p> 
3- A long-time free rider begins to make a late contribution.	12	<p>Team 14 – A part of the final document is written by Student 78 who was not making significant contributions before (dark blue). Mid-term, the teammates commented: “<i>He carried out his task, but was reluctant to meet up when we were trying to arrange meetings and either turned up late or didn’t turn up.</i>”</p> 
4- A non-contributor who is not free riding.	3	<p>Team 13 – Despite his or her effort, the contributions of a member who keeps trying over time (green) is removed from the final document.</p> 
5- A contributor constantly contributes a fair amount.	14	<p>Team 33 – All team members are making an equal contribution over time.</p> 
6- A diligent isolate takes over the work in the team and over-contributes.	15	<p>Team 01 – A member (indicated in blue) rewrites the majority of the final document.</p> 
7- The team starts to work with and help a diligent isolate.	7	<p>Team 07 – While the majority of the work has been written by Student 44 (green), other team members (light and dark blue, light and dark orange) start to contribute. Mid-term, the teammates commented: “<i>She put in lots of effort and worked incredibly hard, so deserves a very high grade. However, I did feel at times she was controlling and took over, not listening to all of our ideas [...]</i>”</p> 
8- A long-time contributor ceases contributing.	4	<p>Team 28 – While a member (dark green) was initially contributing significantly, the member stopped contributing at the mid-term.</p> 



An initial analysis of the effects of coping actions also reveals that indeed some of the coping actions trigger contribution. While some coping actions are useful as temporary remedies with a short-term effect, others have a long-term and more consistent effect. For example, when it was announced that a peer evaluation would be run it encouraged a few non-contributors to write in the document, but most of them stopped contributing soon afterwards. However, the weekly breakdown of the activities seems to have longer term effects. It is worth mentioning that in most cases, we observe that the effect does not last long, as free riders continue to free ride over time.

### PLAN FOR THE MAIN STUDY

Despite the interesting insights from the pilot study, we plan to run a main study. First, the pilot data has some holes since some teams switched to offline word processing tools despite clear instructions to the contrary. In the main study, they will be monitored so that they do not switch to offline tools. Second, because the coping action of running peer evaluations was announced orally, some students who did not attend the classes missed the announcement; therefore, in the main study a formal message will be sent out. Third, in the main study more actions will be performed. For instance, as a preventing coping action, we will ask students to sign a “Team Agreement” (Squires 2014) which explains that contribution will be monitored and used in determining the student’s final grade. Also, we will examine how the coping actions affect any of the dynamic transitions discussed above. Here our analysis will be inspired by event study, defining event windows of different length for examining the effect of the coping actions as compared to a normal level of contribution without the performed action. Fourth, in the pilot study, consent was received ex post data collection, rendering a considerable part of the data unusable for research purposes; therefore, this data could not be used in the analysis that led to the pilot findings. In the main study, consent will be received upfront. Finally, as the first author teaches multiple workshops, there is some scope for experimental manipulation while collecting data for the main study. For example, we are planning to have some teams sign the team agreement and others not so that we can analyze the effect of this particular coping action.

### CONCLUDING REMARKS

In this study, we aim to increase our understanding of the dynamics of contribution to teamwork and the effects of coping actions carried out vis-à-vis dysfunctional contribution behaviors. In a pilot phase, we studied 29 student teams that worked in a partially virtualized environment over three months. In a preliminary analysis of the collected longitudinal data, we developed different dynamic archetypes of contribution behaviors as well as the effects of coping actions.

Despite its potential contributions, this study has some limitations. First, a downside of using IT to measure contribution is the assumption that equal contribution means an equal amount of time spent or output produced (e.g., the length of the text written). Therefore, this approach fails to consider significant contributions such as coordinating the team or generating a new idea. Second, this study does not capture other dynamics besides coping actions in project teams that might influence team members’ contribution behaviors. Future research can use complementary interviews to gain insight on such dynamics.

The IRWITPM will provide us with an invaluable and timely opportunity to present our pilot findings and plans for the main study and to receive some feedback on how to proceed with data collection and theory building.

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