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Taking the Reins and Letting them Go: Mentorship of Scientific Swift Teams

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Abstract

Background: Complex, knowledge-intensive projects present challenges in terms of defining the work and determining roles. Time pressure makes these challenges more acute. External leadership can provide necessary direction and shape, giving the work a clear focus guiding the team's efforts. With hackathons and rapid product prototyping more feasible than they ever have been, collaborations that fast-track innovation by drawing together teams of unfamiliar experts are more common than ever.

Method: Drawing on the process perspective on creative action, we seek to understand the generation of new ideas and solutions when teams are working within an extremely brief time frame of one week. The influence of mentors on these interactions has received limited attention. We fill this gap through a study of fifteen case teams who participated in a week-long boot camp where they generated proposals for public health studies, guided by mentors who were experts in the field. The teams' proposals were evaluated by independent panels, and the evaluations provided metrics for team success.

Results: Our results suggest that even in short-term teams, the timing of mentor interventions is critical to team success.

Introduction

A common concept is that innovation develops over long time horizons. Examples of product development in design firms [1] and drug development in pharmaceutical companies [2] rely on the conventional conditions for novel outputs. However, time is not always available, particularly when addressing pressing public health issues requiring rapid innovation. Since COVID-19, interest in rapid response collaborative idea generation has increased, particularly in public health [3, 4]. Accelerated collaboration has led to novel outcomes including identifying and treating COVID-19 [5, 6]. This work builds on growing interest in hackathons and start-up accelerators, known as idea "sprints" [7, 8].

While there is multi-disciplinary interest in rapid idea generation, we know little about supporting teams conducting deep knowledge work on shortened timeframes. How do these short-term collaborations generate solutions under time pressure? To address this issue, we studied the role of external support in accelerated collaboration. Drawing on the process

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perspective on creative action [9,10,11], we examine how mentor help can assist teams generate ideas under time constraints. External leaders may emphasize control to ensure timely progress, even if decreasing team involvement [12,13]. However, autonomy-supportive leadership can increase intrinsic motivation, enabling team initiative for idea generation [e.g., 14, 12, 15].

To address tackling ill-structured problems quickly, we conducted comparative analysis exploring mentor impact on short-term collaborations and outcomes. Teams of experts meeting for the first time were convened Monday morning to generate and present a public health study to experts by Friday. Each team received a mentor to support progress. Like other ad hoc teams, these units had no clear process [16] for approaching the problem. After four days, each team presented final ideas to evaluators who assessed study design, feasibility, innovation, and team cohesion.

Phases of Team Functioning

Research suggests that external help can contribute to team success [e.g., 29, 30]. External help provided to collaborations usually requires drawing from support of individuals with specialized knowledge of the topic or problem. When tackling complex work, external mentors often interact with collaborators and recipients of their expertise for long, concentrated sessions or repeatedly throughout a project's lifespan. Scholars highlight how time-intensive, deep-help processes support teams by guiding and delving deeply into a single issue through several multi-hour interactions and path clearing: pushing teams through iterative cycles and enabling new approaches to deal with team obstacles over time [31]. However, in swift collaborations with limited time and where external support is even more necessary for fast-track planning and action, it remains unclear what approaches mentors can use to effectively support collaboration.

External mentors, therefore, have several priorities as they support creative teams. First, they must observe group processes, focusing on, and perceiving cues during interactions [32]. With this information, they assess what could most benefit the team - including problem definition or strategy - and whether the team would be open to intervention. Another important decision of an external mentor is how much to shape a team's vision and direction. In the first phase of the creative team process, external mentors can guide the team in mission formulation to help formulate and define a problem. However, such guidance could be received differently by each team member as it could support self-esteem [33, 34]; or could feel intrusive if mentors are

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perceived to be leading rather than helping [35], and not supportive of internal team processes [36]. Moreover, existing literature on teams suggests that mentors can shape the creative team process by supporting collaboration among members, allowing the team to develop together, and encouraging collective goal-setting without over-intervention [37]. Thus, external mentors shape the innovation process of innovative teams; however, open questions remain regarding their role in short-term team development.

To address the challenge of quickly tackling an ill-structured problem, we conducted a comparative analysis to explore the variation in the impact of team mentors on short-term collaborations and their work outcomes.

Materials and Methods

Research Setting

To study fast innovation, we investigated innovation teams in the field [38, 39]. Teams participated in a NIH-funded interdisciplinary boot camp designed to promote scholars' interest and engagement in seeking transdisciplinary solutions to real-world problems. This annual training institute connects behavioral scientists, nurses and physicians, computer and data scientists, and engineers to develop participants' capacity and self-efficacy for transdisciplinary mHealth collaborations, and to enhance their appreciation of varying disciplinary perspectives. .

Cases and Procedure

We collected data from five teams (seven members per team) each year from 2017 to 2019. Thus, our dataset includes 15 total case teams (N=15) which included 105 individual team members across three years. No teams or team members repeated participation across years. The teams were given one business week to incorporate the expertise of all team members into a health-focused NIH-style grant proposal. Each team included members with varying levels of expertise, including graduate students and postdoctoral fellows, as well as assistant, associate, and full professors. Each team had four days, from Monday to Thursday, to draft a proposal and prepare a presentation. On the fifth day (Friday), the teams delivered their oral presentations to a panel of judges including faculty mentors, invited speakers, and invited NIH program officers.

Each team was assigned a faculty mentor whose role it was to provide guidance and expertise to the team. Mentors selected were all established experts in their subject matter area. Whereas some mentors participated in the program for several years, each mentor advised only

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one team per year. As such, each team only had exposure to their assigned mentors. Each year, mentors were informed about their assigned team's topic area, which aligned with their own area of expertise, and always were provided information about key deadlines and expected deliverables.

No explicit guidance regarding the extent and nature of their involvement with each team was given to mentors; and each mentor had autonomy over the amount, nature, and timing of their support for their mentee teams. In other words, the mentors were not trained nor instructed on how to mentor their team and were free to enact mentorship behaviors as they saw appropriate. This variation allowed us to explore the impact of different approaches on team development and outcomes.

Data were collected from two sources. First, we obtained the transcripts of each team's discussions over four days of meetings. We have complete transcripts for 13 teams. Only two days of transcripts were collected for the two teams. Mentor failure to record all sessions often reflects technical difficulties or omissions. Second, we collected evaluations of teams' deliverables, consisting of an oral presentation and written proposal introduced in 2018 and 2019. There were no written proposals for 2017. Each team presented to an expert panel of faculty mentors, invited speakers, and NIH program officers. Written materials were scored by independent evaluators not involved in the current bootcamp, including PI colleagues, NIH program officers, and faculty mentors from the previous years. The evaluators were faculty members with expertise relevant to the team focus. Faculty members were selected on the basis of publishing and funding histories from institutions across the country. Each evaluator completed a detailed grading rubric for each team in order to provide performance impressions. The evaluation criteria are presented in Table 1. Each team received a final overall score. Team scores were separated from the transcript and transcript analysis processes.

Data Analysis

Our analysis focuses on team dynamics and the impact of mentor behavior on each team's success, as defined by the evaluation scores. The week-long study was divided into three phases. The first phase spans from Monday morning to Tuesday mid-day. The second phase encompasses Tuesday's final session through to Wednesday. The third phase included thursday meetings. The teams presented proposals on Fridays. Because mentor behaviors have different

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impacts depending on the phase, a longitudinal analysis is essential for understanding the impact of leadership behavior on team performance.

Because of our exploratory content analysis, we employed an iterative nascent theory approach, deemed the best fit for a longitudinal study using qualitative data to contribute new swift team leadership constructs [38]. A multistep inductive live-coding process was implemented using Atlas.ti to understand the dynamics, allowing data and codes to inform each other [40]. We open-coded the data to determine speech patterns and behavior types. We devised a focused coding scheme, including codes from open coding and auto-coding of phrases identified as important, based on prior research.

Phrases and figures of speech were coded. The coding scheme was refined to add the necessary codes and eliminate redundant codes. The codes were sorted into analytical categories, allowing the assessment of group processes and mentor behaviors. Coders identified the Agent of specific behaviors and actions. Behaviors were identified as either performed by the mentor and assessed in Mentor Behavior analysis or as enacted by team members and analyzed in group process evaluation. The final coding categories and schemes are described in the following sections, and the codebook is presented in Table 2.

Coding of Mentor Behavior

The coding categories for mentor behavior were derived from existing scholarship on leadership styles and their impact on team behaviors. Prior literature indicates that impactful mentor behaviors include Critical Evaluation, Technical Expertise, Motivating Others, and giving a team Autonomy [42, 43]. Thus, these comprise the mentor behavior code groups used in our analysis. Codes within the Critical Evaluation category indicate interactions in which mentors challenged team members' contributions in question or comment form, as well as content questions in which the mentor pushed team members to explain their thinking. Technical Expertise codes demarcate instances wherein the mentor asserted their own expertise, provided technical guidance in the form of comments or questions, or provided connections to outside technical resources. The Motivating Others category contains codes for positive expression such as "That's great", inviting comments, and validating comments like "Yes I agree" and "This is what you mean, right?" Finally, codes in the Autonomy category capture instances wherein the mentor invited and validated contributions from the team, asked questions to promote team-

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member participation, and facilitated access to outside resources. The codes that were used to assess mentor behavior are described in Table 2.

An additional and related metric was used to supplement the measurement of Autonomy. In addition to the behavior codes, we also measured how much the mentor (as compared to the team members) spoke during sessions. Whereas it certainly is possible for a skilled mentor to combine plentiful verbal guidance with ample encouragement for autonomy, a high proportion of speech from the mentor as compared to the seven team members - especially under the very limited timeframe available to these teams - could be an indicator of how much the mentor directed proceedings. For this reason, the amount of mentor speech is a useful metric for Autonomy when combined with behavioral coding analyzing the content of the speech (e.g., inviting others to talk; dominating discussion with lengthy soliloquy about their own experience and expertise).

When calculating overall scores for Autonomy, team member behaviors demonstrating autonomy were also incorporated with the coded mentor behaviors and proportion of mentor speech to team member speech. Autonomy codes for team member behaviors are discussed under “Coding of Group Processes”.

Longitudinal Qualitative Assessments

The behavior codes were a navigational tool that allowed us to make sense of the data at a granular level and see how it fits into a larger picture. However, the codes themselves do not fully constitute findings or analyses; They must be contextualized and used with other analytic methods [41]. While coding the documents , the coders also created an “analytic artifact” for each team in the form of a chronologically mapped transcript summary [41]. These summaries are qualitative assessments of the mentors' behavior based on the above discussed code groupings. In these summaries, coders noted the tone and tenor of proceedings, interactions amongst group members, and notably, if informal leaders emerged from within the teams enabling the teams’ transitions towards autonomous behavior.

Coding of Group Processes

Observing mentor behaviors alone does not allow for a complete comprehension of their role in intra-team dynamics. In tandem with mentor behaviors, we also evaluated group processes over time. During coding, specific behaviors and actions identified in the transcripts as being performed by the mentor were assessed in the evaluation of the mentors, whereas

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behaviors enacted by a team member were analyzed in the Group Processes evaluation. The specific group processes assessed included Interpersonal processes involving behaviors that bolster teamwork, Transition processes including activities that clarify goals and strategy, and Action processes that involve progress monitoring and maintenance behaviors. Interpersonal processes were included to account for the impact of social behaviors at different phases of team idea generation and enactment [11]. Transition and Action processes allowed us to evaluate team idea generation and enactment over the study period [44]. Evaluative sub-categories within each process are detailed in Table 3.

As previously mentioned, team member behaviors were included in the assessment of Autonomy. Team member acts of autonomy include team member displays of informal leadership, steering the conversation, and assigning and volunteering to complete tasks. When calculating overall scores for Autonomy, team behaviors demonstrating autonomy were incorporated along with mentor behaviors and speaking proportion.

Scoring of Behavioral Coding

The categories identified via the coding process are outlined in Table 2. Preliminary scoring of these coding categories involved taking a frequency count of entries in each category, per study phase, team, and year. However, given the variation in transcript length (ranging from half an hour to two and a half hours), and the number of transcripts per phase (ranging from one to four), a direct frequency comparison would not be meaningful. Instead, we calculated the proportional frequency of each behavioral code per team, phase, and year. Once we identified and coded a total number of mentor behaviors in a specific program year, phase, and team, we used this number as the dominator. Then we calculated the proportion of mentor behaviors by coding for the frequency of a particular type of expertise. We used this number of instances of a particular type of mentor behavior as the numerator. For instance, if the total number of mentor behaviors for the 2017 Team 5 during Phase 1 was 150, and the total number of technical expertise was 49, we would deduce that this type of mentor behavior occurred about one-third of the time (49/150 = 0.326). By performing equivalent calculations for all five 2017 teams across coding categories and phases, it was possible to make comparisons of the teams' actions across phases within that cohort year. Mentor and team evaluations were constructed for each of the three study phases based on the proportional frequency of each code grouping present in the transcripts, as well as the longitudinal qualitative assessments. The longitudinal qualitative

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assessments provided an opportunity to triangulate the coding results and ensure that the coding schemes were producing results consistent with a deep examination of each transcript as a standalone datapoint.

Evaluation of Proposals

As previously discussed, all teams' presentations were evaluated by an expert panel of faculty mentors, invited speakers, and invited NIH program officers. Additionally, the 2018 and 2019 teams' written proposals also were scored by a body of independent evaluators who had no involvement in the current year's bootcamp, including colleagues of the PI, NIH program officers, and faculty mentors from prior years. (Evaluation criteria changed between 2017 and 2018 as the program coordinators refined their rubric to align more closely with that used by NIH study sections.) The evaluation for both the written proposals and the oral presentations addressed implementation activities, significance of the proposed project, clarity of aims, innovation, application, appropriateness to the problem statement, and approach to creativity. The evaluative criteria can be found in Table 1. Because the evaluation criteria and procedures, as well as the mentors and evaluators, changed between years, between-team comparisons of outcome scores only were possible within each year. To enable comparison of team performance across years, these outcome scores were used to rank teams within each year from first to fifth place.

Results

Given that the NIH bootcamp involved only the development of proposals and not the execution, this study focuses specifically on the impact of mentors in the creative design-proposal process. The results of our study highlight the importance of timing in mentor interventions. There is a significant relationship between team evaluations and the type and timing of interventions.

Our data reveal that collaborations differed in the extent to which external mentors provided expertise and placed problem structure around the mission and planning process. Some mentors overlaid problem definitions and frameworks from their prior work experience to shape the team's aims, while others encouraged team members to contribute ideas. Among the mentors who provided problem scaffolding at the onset, a subset continued to provide high structure to the team's process over the remainder of the week. Other project mentors limited their involvement over time, letting individual members address the problem ambiguity independently

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and shape their shared understanding of the problem collectively. Some mentors were hands-off initially and intervened towards the end when they became concerned about the team's productivity. Differences in intervention type and timing turned out to be very important.

The highest-performing teams in all three cohorts share a pattern of mentor interventions: All three teams received Technical Expertise and perhaps one or two other mentor behaviors during the first two phases of the bootcamp, and were granted full Autonomy in the final phase. This pattern of mentor behavior is limited to first-place teams. The 2017 first-place team was provided Technical Expertise in the first two phases, as well as Critical Evaluation in the second phase. They enjoyed varying degrees of Autonomy throughout the trial. The 2018 first-place team received only one mentoring behavior in the first two phases of the trial: Technical Expertise, while exercising varying degrees of Autonomy throughout. Mentor behaviors followed a similar pattern for the 2019 winning team, but with the addition of interventions to Motivate Others during Phase 1.

Across all team rankings in our sample, the second-place teams experienced the least consistency in the mentor behaviors they received. The second-place teams all received Technical Expertise in the first phase, but mentor behaviors varied in the second and third phases. Mentors of all three teams exhibited some Motivating Others behavior in the second or third phase (and, in the case of one team, in both phases). Only one second-place team experienced Autonomy in the third phase, accompanied by other mentor behaviors.

Across cohorts, the third-place teams received comparatively little Technical Expertise, little to no Autonomy, and lots of steering and Motivating Others.

Among the fourth-place teams, two of the three experienced Autonomy in the first phase. (The 2019 fourth-place team was missing data from its first phase. As it was the mentors' responsibility to ensure that recordings were made, this could indicate that the mentor was not present, was absorbed with technical difficulties, or otherwise not engaged.) While Autonomy was universal in the first phase, only one team experienced Autonomy in the second phase, in combination with Motivating Others. None of the fourth place teams experienced Autonomy in the third and final phase. The ubiquity of Autonomy during Phase 1, combined with this lack of later-stage Autonomy, could suggest that these mentors were trying to 'catch up' after initially providing little guidance.

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As with the first-place teams, all fifth-place teams experienced Technical Expertise in the first phase. During the second phase, however, mentor behaviors demonstrated the full gamut of all four behavior categories. During the final phase, the mentors of all fifth-place teams demonstrated Motivating Others Also during this phase, mentors frequently interjected with steering comments and questions which led the conversation and the team's direction.

These results show the importance of particular behavioral interventions in particular phases. While first- and last-place teams all experienced tTechnical Expertise in the Phase 1, the fifth-place teams had no Autonomy. Ultimately, they were subject to motivational interventions while the first-place teams were given Autonomy.

Levels and Timing of Autonomy

The data revealed that teams evolving towards autonomy had the highest outcome rankings. Previous studies have claimed that technical expertise and guidance are most important for team creativity and innovation [43]. In our data, technical expertise and motivation were essential to the team transition and action processes in the first two phases. Technical expertise in Phases 1 and 2 correlated with high outcome scores. However, the teams that were fully autonomous in the final phase achieved the highest scores across all years. Mentor exhibition of motivating behaviors correlated with poor team outcomes, especially in Phase 3. Teams with the highest scores received fewer traditional motivational behaviors from the mentors. Only one first-place team had a mentor providing motivating behaviors in Phase 1, and none in Phase 2.

Mentor behavior, particularly autonomy, significantly impacts group transition processes. Group transition processes (see Tables 3, 4, and 5) enabled collective efforts to identify goals and work towards solutions. The transition processes include Goal Specification, Mission Analysis, Planning, Recapping Achievements, and Strategy Formulation, which represent teams translatating goals into proposals and presentations [28].

Within-Team Dynamics: Group Transition Processes

This study focuses on mentor interventions within teams. We explore within-team dynamics, as teams were responsible for producing proposals, and these dynamics were impacted by interactions with their mentors. For example, one mentor displayed technical expertise by describing a clinical trial they designed to highlight potential pitfalls of the team's proposed design. The mentor concluded, 'Don't think people won't notice, I've done it. Yep, you name any mistake, and I have made it.' This disclosure could invite group members to participate in an

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environment where mistakes are to be learned from, easing anxieties. By contrast, another mentor opened a session by speaking about themselves and concluded, '…the reason why I wasn't here yesterday was that it was very hard to turn down a meeting with our chief medical officer at SAMSA.' They boastfully drew upon their experiences and expressed self-perceived expertise. This mentor evolved away from autonomy and the team ranked fourth in their cohort.

External mentors can take over operations to the detriment of group goal specification. One mentor said, 'You want to have some interviews at the start, you want to have some interviews at the end. You want to have some measures of usability and satisfaction with the intervention, usability stuff [all that good stuff], but we actually have some actual robust experiments embedded in… Marta you seem very concerned.' Here, the mentor determines the outcome type, procedures, timing, and measures needed, backing up their ideas by calling them robust. Only in the end do they acknowledge a team member's hesitation. Within-team dynamics are juxtaposed with mentor behaviors that affect impacts. While these behaviors were common among mentors with technical expertise, they minimized team autonomy in the final phase.

First-place teams experienced early and second-phase technical expertise and evolved toward autonomy. Teams evolving towards autonomy showed within-phase movement through transition processes, enabling them to formulate strategies. These teams engaged in collective goal-specification activities across all phases. Teams experiencing autonomy spent more time on goal specification. The goal specification is the "identification and prioritization of goals and subgoals for mission accomplishment" [28]. Teams with autonomy in the final stage yielded higher-rated proposals; thus, collective goal specification processes served as important synthesis steps. Goal specification was an observed transition process in all phases for first- and second-place teams. Our data shows that goal specification and shared meaning emerge when mentors provide technical expertise without micromanagement. These mentors allow teams to organize and design proposals that are clearly communicated to the evaluators.

Discussion

This study aims to fill gaps in scholarship regarding the impact of mentors on short-term teams by addressing how mentoring enables success in short-term ad hoc teams. We build on work that takes a temporal perspective to explore whether strategies supporting accelerated innovation should adjust over the team's lifecycle. Our findings highlight interventions that shape team trajectory early, yet enable teams to become more self-directed over time [45]. Leaders who

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quickly cultivate mutual support and collaboration enable team cohesion [46] and mitigate their need to intervene in the critical Phase 3 time crunch. By studying 15 swift teams, we identified mentor behaviors in specific phases that best supported the successful outcomes.

First, all collaborations in this study included the same number of members, with similar diversity in knowledge and experience. All the groups were newly formed and had the same resources, including a qualified mentor to facilitate their work. All teams had identical task assignments, performance guidelines, and time constraints. However, teams under similar conditions but experiencing varied external facilitation performed differently. There are implications for the development of problem-focused teams that work under time pressure.

Our results show that expert mentors can expedite problem solving by helping teams identify key aspects of problems and establish shared meaning for collaboration. However, our data suggest that directive facilitation at later stages may reduce team performance, particularly when the initial interventions are limited. The data revealed that collaborators benefit from guidance when working on ill-defined, complex problems over short periods. Inexperienced and newly formed teams cannot always discern all relevant nuances of a problem. This complexity renders project planning challenging. Early guidance from mentors helps teams converge efficiently around shared priorities. Limited autonomy is helpful at the onset of short-term collaboration before teams establish a shared understanding of their goals. Yet, as our data demonstrate, a lack of autonomy impedes the later phases of team problem-solving. For teams to realize their potential, autonomy is required to foster deep discussion and joint work necessary for novelty and impact.

Theoretical Contributions

This study makes two theoretical contributions. First, it provides details about how teams under time constraint approach ill-structured problems, as well as shedding light on how external mentors can enhance or hinder innovation. We accomplished this by looking at the development of innovative processes and the unfolding of group phases through the lens of external mentor behaviors. That is, we examined the facilitation strategies of mentors who are subject matter experts in relation to the success of their teams. In that sense, we take a fine-grained look at the impact of interventions made by competent, well-intentioned experts on the processes of innovative teams.

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The second theoretical contribution of our work is the introduction of a group-level theory describing the role of autonomy among teams of experts tackling complex and ambiguous projects. Our work strongly suggests that receipt of help from an expert mentor on complex projects is linked to the novelty of a team's solutions in early stages, but teams need to become autonomous and allow for informal leaders to arise in order to successfully produce innovative ideas. Still, there are limitations to the value of mentor intervention when it carries forward past the initial stages. Thus, as theories of organizational creativity and innovation have become more dynamic [47] and address diverse experts working together to create value [48], so, too, is it important to develop theories of external support to explicitly include the role of inputs and processes that shape how collaborations evolve over time.

Study Limitations

Our study has limitations that suggest directions for future research. First, our research does not allow us to standardize onboarding or characteristics of mentors and the groups they supported. In our study, the research team examined audio files after the completion of the training and had little to no influence as to how mentors were recruited, selected, or onboarded to participate. Future research should investigate the impact of the timing and nature of support, while also seeking to minimize the within- and across-mentor differences that could influence team processes and outcomes. Although conclusions can be drawn from an analysis of the behaviors and timing of mentors, further generalizability could be achieved through future research efforts by providing standardized mentor training a priori.

Second, our research spanned a three-year window, during which changes to the research evaluation protocol occurred. While the unique and rare access to swift ad hoc teams warranted a longer window of investigation, the decision to use different evaluation tools during the study did have an impact on the ability to conduct cross-team comparisons. Although we were still able to differentiate based on performance, having the same metric consistently would have enhanced the research study. Future research is encouraged to study ad hoc team performance using standardized and consistent measurement to increase reliability and validity of conclusions made.

When complex and knowledge-intensive projects are ambiguous, expert external mentors can provide initial framing and direction. Our study highlights the critical role that external mentors play in reducing ambiguity by initially providing focus, and then skillfully shifting agency back to team members so that they may generate ideas and solutions within this better-

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defined problem space. As there is an increased real-world utilization of cross-functional collaboration and short-term idea generation, it is vital to understand how and when to support the teams doing this work. Facilitating success means that mentors must be prepared to take the reins, and then let go.

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Competing interests

The authors declare none

Author Contributions

Sara O'Connor: Conceptualization, Formal analysis, Methodology, Supervision, Writing-original draft, Writing-review & editing; **Maritza Salazar Campo:** Conceptualization, Formal analysis, Funding acquisition, Methodology, Project administration, Resources, Supervision, Writing-original draft, Writing-review & editing; **Teresa Madamba:** Writing-review & editing.

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Table 1 ***Evaluative Criteria***

Evaluative Criteria		
2017	2018	2019
Did this team have a well-defined topic?	Implementation	Implementation
How well-prepared was this team? How well did they know their material?	Significance	Significance
How well-organized was the presentation? Did the group use time effectively?	Aims	Aims
How well did this group address the scientific aspects of its topic?	Innovation	Innovation
How interesting and creative was this group presentation?	Appropriateness	Appropriateness
How effectively did this group deal with questions and comments?	Creativity	Creativity
How effectively did this group work together as a team?	Overall Score	Overall Score
Did the final product reflect domain expertise?		

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Table 2 ***Codebook***

Interpersonal Processes	Conflict Management	Resolution, I apologize, sorry– Only If Not Mentor
	Motivation and Confidence Building	Positive expression, inviting comment, inviting question, validating comment- Only If Not Mentor
	Affect Management	Inviting comment, inviting question, kind hearted personal comments and questions, kind hearted work related comments, kind jokes, kind/funny comments, problem solving- Only if Not Mentor
Transition Processes	Mission Analysis	How about? planning, recapping, What if we?
	Goal Specification	Outcome identification
	Strategy Formulation	Assignment/delegation, process questions
Action Processes	Monitoring Progress Towards Goals	How's it coming? update, recapping, check in,
	Systems Monitoring	Device specification, human subject identification
	Coordination	assignment/delegation, volunteering, team management, problem solving, planning
Mentor Behavior	Critical Evaluation	Challenge comment, challenge question, content questions
	Autonomy	Connecting others, Inviting question, inviting comments, questions, process questions, absence of soliloquy and steering codes
	Technical Expertise	Asserting Expertise, assignment, process questions, self-referential, steering comments
	Motivating Others	Good expressive, inviting comment, inviting question, motivational phrases, validating comments, validating questions

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Table 3 ***Group Behavior Analysis***

Interpersonal Processes	Transition Processes	Action Processes	Mentor Behavior
Conflict Management Motivation and Confidence Building Affect Management	Mission Analysis Goal Specification Strategy Formulation	Monitoring Progress Toward Goals Systems Monitoring Coordination	Critical Evaluation Autonomy Technical Expertise Motivating Others

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Table 4 ***Team Scores***

Team	Mentor Behavior-Beginning	Mentor Behavior-Middle	Mentor Behavior-End	Rank
2017 T1	Critical Evaluation, Technical Expertise, AutonomyMotivating Others	Motivating Others Autonomy	Motivating OthersTechnical Expertise	4
2017 T2	Technical Expertise, Critical Evaluation	Technical Expertise, Autonomy	Motivating Others	5
2017 T3	Technical Expertise, Critical Evaluation. Very much trying to keep people on task	Not giving Autonomy, still very much trying to steer, keep them on track, telling them what they need to accomplish	Technical Expertise, Motivating Others, no Autonomy, some limited Critical Evaluation	3
2017 T4	Critical Evaluation, Technical Expertise	Critical Evaluation, Technical Expertise	High Autonomy, Motivating Others, Critical Evaluation.	2
2017 T5	Autonomy, Technical Expertise, Critical Evaluation	Technical Expertise, Autonomy	Autonomy	1
2018 T1	Autonomy, Technical Expertise			5

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2018 T2	Technical Expertise, Social Support	Social Support, Technical Expertise	Asserting Expertise	3
2018 T3	Technical Expertise	Technical Expertise	Autonomy	1
2018 T4	Asserting Expertise, Motivating Others, Technical Expertise, Critical Evaluation	Motivating Others, Technical Expertise	Autonomy, Technical Expertise	2
2018 T5	Autonomy	Technical Expertise, Motivating Others	Motivating Others, Critical Evaluation	4
2019 T1	Motivating Others, Technical Expertise	Technical Expertise	Autonomy	1
2019 T2	Technical Expertise	Critical Evaluation, Motivating Others	Motivating Others	5
2019 T3	Motivating Others	Motivating Others, Autonomy	Motivating Others, Critical Evaluation	3
2019 T4		Technical Expertise, Motivating Others	Critical Evaluation	4
2019 T5	Technical Expertise	Motivating Others, Autonomy	Expertise, Motivating Others	2

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Table 5 ***Group Transition Process Results***

Team	Beginning	Middle	End	Rank
2017 T1	Mission Analysis, Strategy Formulation	Goal Specification, Strategy Formulation	Strategy Formulation	4
2017 T2	High Mission Analysis: formulation and planning. Low Goal Specification	Mission Analysis, Strategy Formulation	High Goal Specification, low Strategy Formulation and Mission Analysis	5
2017 T3	Mission Analysis, Strategy Formulation	Goal Specification, Mission Analysis	Mission Analysis and planning. Enacting strategy. Reactive strategy adjustment. Strategy Formulation.	3
2017 T4	High Goal Specification, Some Mission Analysis	High Goal Specification, some Mission Analysis and Strategy Formulation (low)	High Goal Specification, high Mission Analysis	2
2017 T5	High Goal Specification	Goal Specification, some Mission Analysis, high Strategy Formulation	Beginning of phase finished Goal Specification, middle of phase high Mission Analysis, high Strategy Formulation at end.	1
2018 T1	High Mission Analysis.			5
2018 T2	Goal Specification and Mission Analysis, Low Strategy Formulation.	Early high focus Goal Specification, evolve towards increasing Mission Analysis and Strategy Formulation.	High Strategy Formulation and some Mission Analysis.	3
2018 T3	Early Goal Specification, high Mission Analysis, mid level Strategy Formulation.	Goal Specification, Mission Analysis, Strategy Formulation.	High goalsSpecification and high increasing Strategy Formulation	1

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2018 T4	High Goal Specification, increasing Mission Analysis.	High Goal Specification, some Mission Analysis, low Strategy Formulation.	High Goal Specification, moderate Mission Analysis and low Strategy Formulation.	2
2018 T5	High Mission Analysis, moderate Goal Specification.	High Mission Analysis, increasing Strategy Formulation	High Goal Specification, moderate Strategy Formulation	4
2019 T1	High increasing Goal Specification, moderate Mission Analysis.	Moderate Goal Specification, increasing high Mission Analysis, moderate Strategy Formulation.	Autonomy.	1
2019 T2	High Goal Specification, moderate Mission Analysis.	High Mission Analysis.	Motivating Others, Critical Evaluation.	5
2019 T3	High Mission Analysis, moderate Goal Specification and Strategy Formulation.	High decreasing Goal Specification and increasing Mission Analysis.	Critical Evaluation.	3
2019 T4		High Goal Specification, increasing Mission Analysis.	Increasing Goal Specification and Mission Analysis.	4
2019 T5	High Goal Specification.	High decreasing Goal Specification, increasing Mission Analysis.	Expertise, Motivating Others.	2

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