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3-4-2020

## Using Escape Rooms for Conducting Team Research: Understanding Development, Considerations, and Challenges

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### Scholarly Commons Citation

Cohen, T. N., Griggs, A. C., Keebler, J. R., Lazzara, E. H., Doherty, S., Kanji, F. F., & Gewertz, B. L. (2020). Using Escape Rooms for Conducting Team Research: Understanding Development, Considerations, and Challenges. *Simulation & Gaming*, (). <https://doi.org/10.1177/1046878120907943>

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# Using Escape Rooms for Conducting Team Research: Understanding Development, Considerations, and Challenges

Simulation &amp; Gaming

1–18

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DOI: 10.1177/1046878120907943

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## Abstract

*Background.* Modern organizations are increasingly reliant on teams, and many organizations are subsequently concerned with the development of interventions that can improve the performance of teams. **Escape rooms** are beginning to receive attention as a potential avenue to facilitate team-based research. Escape rooms are **team-based** recreational activities that require a team of individuals to work together and think critically in order to solve a series of puzzles or challenges to *escape* a room.

*Purpose.* This article provides considerations for researchers and organizations alike concerning the development of an escape room for team-based research, its **methodological applications**, and **challenges** associated with the use of escape rooms in research. Developmental considerations include issues such as an escape room's location and size, financial considerations, theme development, other characteristics of the escape room, the development of puzzles and challenges, prototyping efforts, and the development of hints.

*Conclusion.* Research considerations include the use of observational and survey methods in data collection, measurement of team processes and team performance, and how elements of an escape room influence **teamwork** and **problem solving**. Various challenges associated with the use of escape rooms in team-based research include

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considerations for dealing with cheating behavior, providing hints to participants, and resetting the room between experimental trials.

### **Keywords**

escape room, methodology, team performance, teams, teamwork

## **Background**

Modern organizations rely heavily on effective teamwork among their employees to ensure success (Fapohunda, 2013). Effective teamwork has been cited as one of the most important components for producing positive outcomes including performance (Khan & Mashikhi, 2017), productivity, motivation, and self-efficacy (Khuong & Tien, 2013). Activities to improve a team's effectiveness, like teambuilding, have been found to relate positively to success (Aga et al., 2016). Teambuilding activities are carried out with the goal of creating positive environments that aid in improving relationships and teamwork (Nicholson, 2018). One innovative activity involves the use of commercialized escape rooms to enhance certain team competencies.

An escape room is an interactive experience, where individuals (usually ranging from 2-8 people) must work together to solve puzzles in order to *escape* the room. The escape room industry is currently comprised of over 8,000 companies across 60 countries ("World of Escapes", n.d.), of which approximately 2,300 are in the United States (Pilon, 2019). Escape rooms are typically themed; creating a fun and immersive environment that requires effective performance in order to succeed. A team's cognitive and social skills both individually and cohesively play a large role in the success of the team (Pan et al., 2017).

In order to succeed in an escape room experience, participants must work together. In other words – a well-designed escape room forces interdependence among multiple individuals who share a goal (Salas et al., 2008b). Therefore, escape rooms can be used as settings to research teamwork in active problem-solving scenarios. To illustrate, medical schools are utilizing escape rooms to improve leadership skills and team dynamics amongst medical students (Wu et al., 2018). In addition to leadership, measurements such as time to complete tasks, number of hints used, number of puzzles completed, communication exchanges, trust between members, satisfaction, and team efficacy are examples of variables that can be collected in an escape room to better understand team interactions.

These are just some of the examples and opportunities for conducting innovative research using escape rooms in the team context; however, the literature is sparse. Moreover, the challenges associated with developing these study environments are difficult to overcome. Thus, the aim of this article is to provide considerations for researchers and organizations alike for using escape rooms for teams research (studies that investigate teams (i.e., two or more individuals working interdependently to achieve a shared goal; Benishek & Lazzara, 2019). In this review article, we will discuss the development of an escape room for teams research, its methodological applications, and challenges associated with their use.

## Developing an Escape Room for Teams Research

There are multiple factors to consider when developing an escape room for teams research including its theme, location/size, cost, room layout, puzzle sophistication, time limits, prototyping, and hints (see Table 1 for a glossary of terms/research methods).

**Table 1.** Glossary of Terms and Research Methods.

Term	Definition
Cheating	A user action that gives players an unfair advantage that is considered unfair by the game developer (e.g., using physical force to open a locked item)
Escape Room	interactive experience, where individuals (usually ranging from 2-8 people) must work together to solve puzzles in order to escape the room.
Facilitators	Sometimes referred to as "Game Masters". Individuals in charge of managing the escape room including escape room setup and reset, providing hints (via a verbal or written source), introduce study teams to the escape room and the research
Hint	A tool utilized during escape room activities that assists a team in moving past a particularly difficult component of the room.
IMOI	Input, mediator/moderator, output model used to identify and measure a variety of factors that best predict team outcomes
Prototyping	Using multiple practice teams of varying size to "test" an escape room's themes, puzzles and technology during the development period
Puzzles	Items in an escape room that must be solved to (A) reveal important information; (B) can be used to solve another puzzle; (C) can be used to escape. Puzzles can consist of real puzzle pieces, a combination of letters, numbers or symbols, hidden text requiring some sort of tool to reveal the text, audio/visual riddles, math problems, etc.
Teams research	Research studies that investigate teams (i.e., two or more individuals working interdependently to achieve a shared goal)

### Theme

Escape rooms typically follow a theme that guides the inclusion of puzzles and props within the room (Nicholson, 2015). Like a movie set without a script, an escape room can feature a consistent theme with no provided narrative. However, many consumers perceive such escape rooms as less immersive than rooms that create a sense of urgency through a compelling narrative (Nicholson, 2015). Research questions and goals can guide decisions concerning what theme is appropriate and the level of fidelity needed in an escape room in order to illustrate the desired theme. For instance, if a research team wished to examine how hospital staff make decisions under stressful conditions, the escape room would need to mirror a hospital environment and possess the ability to induce stress. This can be achieved by manipulating environmental factors of the room such as its lighting, or the introduction of narrative elements aimed to induce stress such as a large clock that displays the team's remaining time.

### *Location and Size*

Researchers must identify a location to house the escape room during data collection. It is difficult for researchers to get participants to travel to distally located simulation-based training sites (Rosen et al., 2016). Thus, an escape room should be located as close to participants as possible. These considerations are also relevant for escape room research endeavors aimed to target participants of a single workplace. Furthermore, the utilization of a proximally located simulation center provides researchers with greater control and standardization concerning their procedures (Rosen et al., 2016). In instances where an escape room cannot be proximally located, providing transportation services to participants can help to ensure adequate involvement. The physical size of an escape room depends on the location, amount of space and number of resources available, and a large space with multiple rooms is not required to have an adequate testbed.

### *Financial Considerations*

Multiple costs are associated with the development of an escape room for research. Researchers will need to dedicate time to develop facets of the escape room such as its theme or narrative, creating a variety of puzzles, building props, creating instructions for resetting the room, or creating a flowchart to track participants' progress. The number and type of props needed for an escape room can change depending on its theme or narrative. For example, themes that make use of more technology such as space-travel or healthcare will require more props in order to facilitate an immersive experience. Conversely, themes that involve less technology such as an office or classroom will require fewer props to create high fidelity experiences. Regardless of theme, it is pragmatic to include a variety of locks, puzzles, or challenges throughout the room in order to encourage teams to think innovatively. There are a variety of commercially available locks or puzzles at multiple prices and levels of complexity, ranging from simple combination locks to advanced fingerprint scanners. Research teams should also consider the use of audio or video surveillance equipment to record participants as they complete the room, which can serve as a data collection method to capture verbal utterances, team processes, and behaviors. While the costs associated with using an escape room for research have been outlined about, it is important to note other costs that should be considered when conducting research using teams. For example, there are additional costs associated with measuring and potentially compensating multiple individuals at one time.

### *Room Characteristics*

Following the above considerations, researchers must determine the characteristics of the room environment and how they will physically position puzzles and props throughout the room. To reduce the potential for distractions or other experimental confounds, the room should be physically isolated from extraneous noises or sounds.

Additionally, the lighting of the room should be controlled such that the level of light remains standardized across participant teams. While dim lighting or the inclusion of sound effects may serve to bolster fidelity and immersion, it can also make observations of participants difficult. It is important that participant actions within the room can be observed either in person or through video surveillance, as this can help to determine if deficits in a team's performance are due to poor puzzle design or as a result of poor teamwork.

### *Puzzles and Challenges in the Room*

Research questions guide the development of puzzles and challenges within an escape room. Researchers interested in the specific abilities of participating teams, such as a nursing team's ability to calculate correct drip rates under pressure, the puzzles and challenges of the room should reflect such abilities in their task demands. Conversely, if researchers were interested in the generic abilities of team members, such as a team's ability to communicate effectively, every individual within the participant team should be able to accomplish each task involved in the room regardless of their background. Puzzles and their associated tasks can have their difficulty raised by requiring greater amounts of teamwork. This can be achieved by physically separating important pieces of information needed to accomplish a task, such that team members must work together in order to complete the task as efficiently as possible. For example, a set of puzzles could require two or more people to physically manipulate multiple objects at different locations within the room at the same time.

Escape rooms utilize a variety of creative puzzles that require individuals to work together and think innovatively in order to succeed. Nicholson (2015) offers a detailed discussion concerning the development of multiple types of escape room puzzles as well as their organization within the room. Many common examples involve unlocking locks with keys and combinations or assembling physical puzzle pieces; however, a puzzle can also refer to a variety of mechanisms or tasks within an escape room. Other types of puzzles may include unveiling hidden text that reacts to light or heat, interpreting complex ciphers hidden in text, matching directional locks with directional clues from maps (e.g. north, south, east, west), or pattern identification. The development of escape room puzzles should also be considered in respect to any time limitations.

Researchers must consider their research question when designing puzzles. In some instances, it may be mandatory for the study group to master a particular challenge to be included in the study sample. For example, consider a study interested in exploring how team members communicate when they are forced to work together under time pressure. Failure to solve a puzzle could result in inability to escape the room or inability to start the task of interest. This is particularly true if the escape room follows a linear design (e.g., puzzle "A" must be solved before puzzle "B" etc.) compared to a non-linear design (e.g., multiple different puzzles could be accomplished in any order). If teams must complete certain puzzles as part of the research design, researchers should consider the role of hints (see section *hints*) in assisting the team with moving

along to achieve all intended goals; however, this may not be necessary or required for all research studies.

### *Prototyping*

Given the challenging nature of predicting human behavior, prototyping efforts utilizing multiple teams during an escape room's development are an effective tool to help estimate the length of time required to complete individual puzzles and the overall length of the room. Understanding the timing allows researchers to assess the perceived difficulty of their room and examine how teams navigate the puzzles. Using teams of varying sizes (e.g., 2-8 individuals), backgrounds, and levels of prior experience with escape rooms, enables researchers to better anticipate optimal team sizes and composition e with regards to the difficulty of their room. Prototyping affords researchers an opportunity to develop and refine standard operating procedures for data collection or the briefing of participants before the escape room. Prototyping also functions as a platform to solicit feedback from participants concerning their perceptions of the room and to report any significant challenges they encountered. To ensure standardization across participant teams and to minimize task load on escape room facilitators, researchers should consider the utilization of pre-recorded instructions for participants in the escape room and the delivery of narrative components. Prototyping can also help determine if and how many hints should be provided to participants during the escape room.

### *Hints*

A hint is a tool utilized during escape room activities that assists a team in moving past a particularly difficult component of the room. While the inclusion of a hint (or multiple hints) during the development of an escape room for research is optional, it provides an avenue to mitigate the unpredictability of human behavior and give teams an outlet to progress past difficulties unanticipated by the escape room developers. A hint can also function as a mechanism to ensure teams progress past interactions that are not the subject of data collection and spend a greater amount of their time on components of the room relevant to the research question(s). The inclusion of one or multiple hints while developing an escape room should be considered heavily; however, inclusion can make interpretation of collected data more difficult due to the emergence of differing behaviors or perceptions as a result of using a hint. Hints can be viewed as a double-edged sword, providing researchers with an avenue to preclude issues resulting from participants' halted progression through the room while simultaneously introducing more variance into behavioral or perceptual metrics.

Introducing the use of a hint can be particularly challenging when using an escape room for research. For one, hints are tightly coupled with specific objects or puzzles within the room, so the researchers must ensure the specific hint provided aligns with



the components within the room. Two, a hint is usually solicited by the team as necessary; therefore, it is unpredictable when teams may request a hint from the researchers. To ensure that the researchers closely observe the teams, (s)he can observe teams via either a video feed or directly by remaining in the room to provide hints directly (i.e., in person) or indirectly (i.e., verbally or written; Wiemker et al., 2015).

Regardless of the timing or medium, hints have potential implications for research. If researchers are not cautious, it is possible to have extensive variability within hints between teams. Hints can artificially influence performance if there are differences in their timing and specificity. To elaborate, the level of instruction within a hint may fluctuate, from very little to a great deal, and it would be difficult to parse apart a team overcoming an obstacle due to their abilities and the hint itself.

To ensure that hints do not have unwanted research implications, we recommend mitigating the potential variability between hints by creating a hint *cheat sheet*. Refer to Table 2 for an example of a hint cheat sheet. The hint cheat sheet will provide systematic guidance on the type of hint that is necessary as well the level of detail that should be provided to teams. By reducing this variability, researchers can get a clearer understanding of a team's ability to overcome challenges and escape the room.

## Escape Rooms as Test Beds for Team-Based Research

The following section highlights some potential avenues for utilizing escape rooms to conduct empirical investigations answering current teamwork research issues. This will include the tradeoffs between observational and survey data, the primary domains of constructs that should be measured, and the utilization of problem solving as a way to enhance teamwork.

### *Conducting Observational and Survey Research on Teams*

A mixture of study types could be utilized to understand teams and teamwork within escape rooms. There are two potential avenues utilizing observational research (i.e., a researcher watches the teams perform tasks in real-time or reviews their performance via a prior video recording) and/or survey research (i.e., questions are asked of the participants before, during, or after participation of the escape rooms). These methodologies are not mutually exclusive research approaches since many studies would likely rely on both to answer various research questions. Observational research, especially when using videos, can lead to a rich plethora of data but comes with the added need for reliable video coding, which can be extremely time consuming. Surveys can measure many of the variables discussed below but are susceptible to bias or rely on perceptions of aspects of teamwork rather than manifestations of actual behaviors. Ideally, studies should utilize a multi-methodological approach; however, the exact methodology will depend on research questions and needs. The sections below will highlight directions that can be taken to understand teamwork in the context of escape rooms.

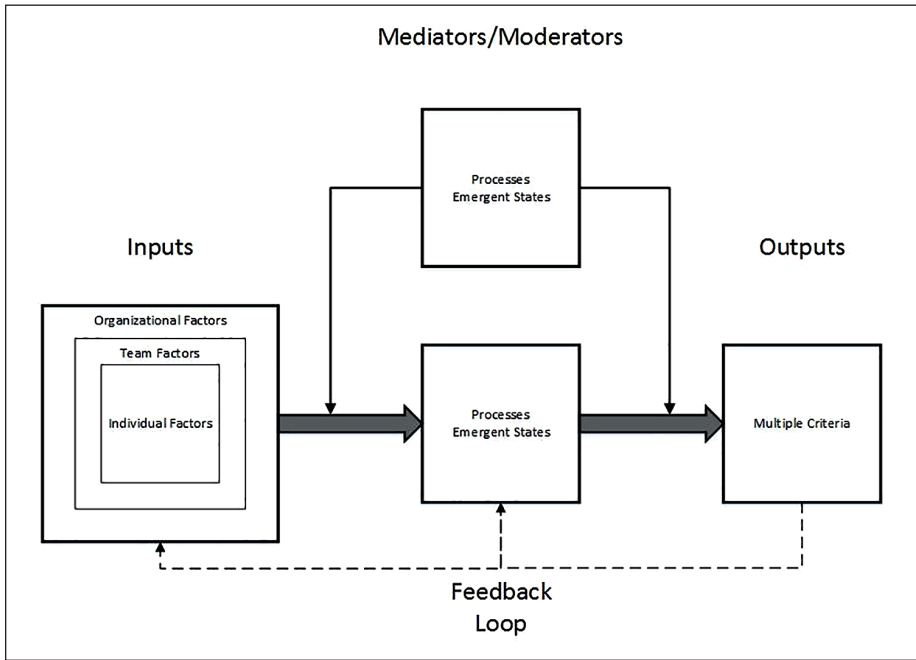
**Table 2.** Description of Hints.

Type of Hint	Point in Room	Object in Room	Example of Hint
Have not accomplished task	Have not completed any puzzles in the room	3 Yellow Bags	You should see 4 yellow bags hanging on the walls. 3 of them are unlocked and have symbols that correspond to the locked bag. Inside the three unlocked bags are pictures of items in the room. You must count the number of items that correspond to the pictures to determine the combination.
Confused on combination order	Found yellow bags but cannot determine order of bags	Locked yellow bag	You must enter the number that corresponds with each symbol in the <i>order</i> that the symbols appear on the locked bag
Confused on purpose of item	Found magnet but cannot determine what to do with it	Magnet	You should see a canister with a blue lid attached to the wall. Use the magnet to retrieve the key
Found item unsure where to put it	Have yellow key but do not know where to put it	Outer door of blood bank	The key has a yellow tag on it. Find the keyhole with a corresponding yellow tag nearby
Unable to locate item	Do not know what to do with gurney	Gurney	Refer to the puzzle

### *Measuring Indicators of Team Process and Performance*

Team performance researchers have expressed and better understood the nature of team performance using a model that describes how inputs lead to mediators/moderators that in turn lead to outputs. This framework, known as input-mediator/moderator-output (IMOI; Ilgen et al., 2005) framework (see Figure 1) can be used to identify and measure a variety of factors that best predict team outcomes in escape room research. We will elaborate on inputs, mediators/moderators and outputs in greater detail below.

Input variables can include aspects of individual team members, the team's composition, the environment, the task, and the surrounding culture of the organization (Ilgen et al., 2005). Input variables differentially affect team interactions and problem solving (Bell & Brown, 2015). Measurement of these variables can give insight into how characteristics of individuals, team structure, task, environment, and organization can affect downstream processes and outcomes. For example, team member familiarity may influence team interactions and problem solving in the room. People who already know each other are likely to bring norms and certain levels of trust that are higher than people who are meeting for the first time.



**Figure 1.** Depiction of the IMOI model.

Mediator/moderator variables refer to aspects of a team that emanate as they work together to achieve goals. More specifically, these mediators and moderators include process variables and emergent states. Processes refer to team members' interdependent cognitive and behavioral activities directed towards a shared goal; meanwhile, emergent states are the team properties that manifest as a function of the inputs and processes (Marks et al., 2001). Examples of mediators and moderators that are potentially interesting to researchers and organizations include conflict management, handling of interpersonal differences, trust, psychological safety, shared leadership, communication, shared mental models, backup behavior, mutual performance monitoring, and adaptation.

Output variables are measures of how well the team performed at achieving their goals, as well as aspects of positive growth in the team. A prevalent and paramount output variable is team performance. There are a multitude of output variables that can be indicators of success outside of *winning* at the room that include learning, changes in team orientation, satisfaction, and team efficacy. Characteristics of the room can inherently influence the success rate of teams, which alters the data that can be collected from their performance. For example, if an escape room is so difficult that very few teams are able to successfully complete the room, teams will consistently experience poor outcomes. Conversely, if an escape room does not pose a significant challenge for any of the participants, there will be little incentive for team coordination.

This can also influence data collection concerning teams' success in the room and related output variables.

### *Understanding the Influence of Escape Room Elements on Teamwork and Problem Solving*

Little is known about the effectiveness of escape rooms as an intervention to improve teamwork. One approach is to not only use escape rooms as a way to study teamwork as discussed above, but another approach is to improve teamwork through the utilization of problem-solving approaches (Cannon & Edmondson, 2001; Edmondson, 1999), which are a key feature of escape rooms. Although preliminary research has been done on this topic, there is little work that details how certain elements of an escape room – including puzzle complexity, difficulty, and type – influence team interactions and downstream performance. The coupling of elements of the escape room with interactions between team processes could have important implications for the use of escape rooms as a team training system. For instance, Tjosvold et al. (2004) discuss how team problem solving utilizing cooperation, competition, and learning can enhance teamwork and productivity. In many ways an escape room taps into these various constructs by forcing individuals to work together (coordination), providing a strict time limited goal of getting out of the room, enabling comparisons to other teams (competition), and by forcing individuals on a team to communicate effectively and efficiently to keep team performance in line with the task and limitations of the escape room (learning).

Regardless of the specific area of focus within a research effort, there are challenges that are inherent with using escape rooms as a research testbed. The following section will highlight multiple challenges and implications associated with the use of escape rooms in team-based research.

## **Challenges**

### *Cheating*

The first challenge that researchers may experience is cheating (i.e., a user action that gives players an unfair advantage that is considered unfair by the game developer; Webb & Soh, 2007). Although cheating in games, especially in more novel game environments, is not well studied or defined (Yan & Randell, 2005), such behavior certainly occurs. For example, individuals may pry open locks as opposed to solving a puzzle to uncover the combination that will open the lock. Consalvo (2005) posits that cheating may be attributable to several motivations 'playing God', gaining advantage over others, experiencing boredom, or getting stuck. Individuals who are 'playing God' are motivated by having fun as opposed to concertedly defeating the game or another player. Players who are drawn towards gaining advantage tend to interfere with others for their own personal benefit. Others may find certain points of a game boring; thus, they cheat to quickly advance through the tedious or unpleasant portions of the game. Finally, some may cheat because they are stuck and cannot progress,

which is most typical in escape rooms. Others have suggested that people cheat from perceived external pressure, fear of failure, lack of integrity, to attain social acceptance, to please others, and to protect themselves (Van Yperen et al., 2011).

Despite the motivation, cheating can have implications for research. Cheating intrinsically alters performance such that assessments of the team are no longer exclusively resulting from the team's performance. Therefore, cross-team comparisons become negated since performance of the team is no longer attributable to their abilities. In instances of cheating, researchers may have to remove that team's data from the sample so as to not artificially skew the results.

To deter cheating, there are several strategies researchers can employ. One strategy is to bring awareness to players (Morch, 2003). Another strategy is to withhold information until it is necessary for the players to have access to it (Li et al., 2004). A third strategy is to create a climate that encourages learning, development, and cooperation (Van Yperen et al., 2011). A final strategy to deter cheating is to clearly define, teach, model, and reinforce desired behaviors surrounding cheating by developing a climate that discourages cheating through mechanisms like accountability or negative consequences and supports integrity through building respect (Lathrop & Foss, 2005). In the context of an escape room, researchers can explicitly request participants to not engage in cheating behavior in the room as well as offer specific examples of behaviors to avoid such as breaking a lock.

### **Resetting the Room**

A team's autonomous interactions with various objects during participation can result in a room that is substantially different from how it was established initially. Consequently, objects in an escape room must be rearranged systematically between participant teams such that their first appearance to each team is constant. Because all of the objects should have a pre-determined location, resetting a room can become challenging especially when particular puzzles have multiple pieces, components, or clues. As there are implications for improperly set rooms, it is advantageous to employ strategies to ensure the room is properly reset. The first recommendation to facilitate resetting the room is to leverage a *reset map*. A reset map provides a visual depiction of the exact location of every object in the room. See Figure 2 as an example reset map. Another recommendation is to stagger the teams. Staggering the teams provides time and opportunity for the researchers to relocate all of the displaced objects.

Inconsistencies across participant teams concerning the arrangement of objects in the room can actually have implications on the study and its findings. That is, reset rooms foster cross-team comparisons when done correctly and impede cross-team comparisons when performed incorrectly. For example, researchers may use time to escape the room as a measure of performance. However, if the room does not adhere to pre-determined, systematic object locations, then it is difficult to determine if performance is attributable to the team's ability or the location of the objects. As another example, performance can be artificially altered if the reset map is unintentionally left within the actual room.

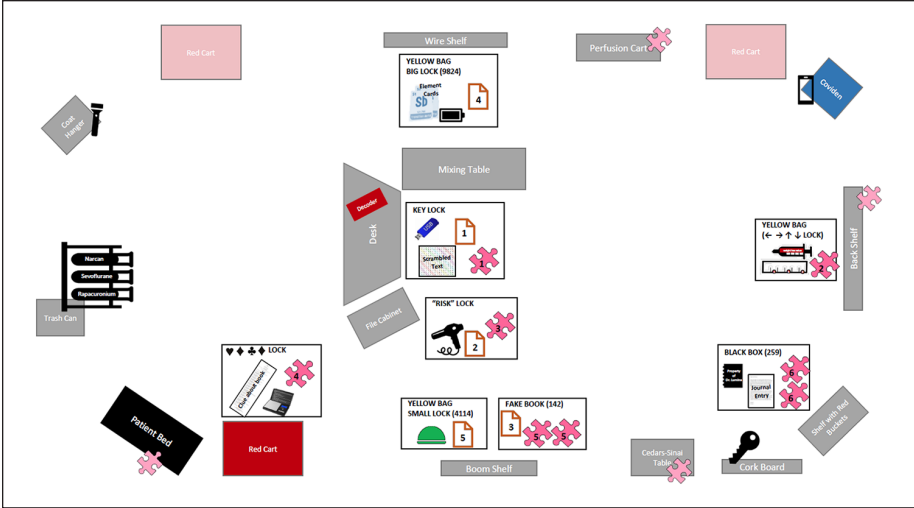


Figure 2. Example reset map.

Teams may use the reset map as a cheat sheet and can solve the puzzles as a result of the reset map as opposed to their actual problem-solving abilities.

### Discussion

Moving forward, the unique nature of escape rooms can provide novel insights into teams, teamwork, and team performance. We have provided multiple considerations to motivate and improve research methodologies using escape rooms. Additionally, using escape rooms in team-based research has multiple theoretical and practical implications as well as limitations.

### Implications

Escape rooms, due to their gamified nature, can provide a unique platform upon which to conduct team-based research by studying teamwork. The characteristics of escape rooms lend themselves to studying teams and teamwork directly through quantified interactions between people that can be evaluated via variables from both input, mediators, moderators, and outputs of those teams (e.g., motivation, problem solving, complexity, and composition). Essentially, escape rooms offer a testbed with systematic task demands across groups, providing researchers with an avenue to compare the differential influences of varying problem-solving approaches, puzzle difficulties, and team compositions on team performance. For example, the gamified nature of escape rooms may offer a means to understand and strengthen team motivation or collective orientation.

In addition to using escape rooms as a mechanism to study teamwork, escape rooms may make a good platform for studying or implementing team training. Meta-analytic

evidence suggests that team training is beneficial (Hughes et al., 2016; Salas et al., 2008a), so having an immersive, engaging way to provide team training can prove to be beneficial for acquiring individuals. Further, having a training testbed that is easily malleable can serve as a way to target specific training outcomes.

Related to training, the use of escape rooms in research also has implications relevant to game-based learning. Game-based learning involves using games as the medium to enhance or accelerate the acquisition of knowledge and skills (Prensky, 2001). Because escape rooms are often considered entertainment, they serve as a means by which researchers can obtain unique characteristics that might not be observable under ordinary circumstances. For example, teams may be more relaxed entering into the escape room in comparison to didactic team-based exercises. However, because escape rooms are frequently seen in the context of entertainment, it is possible that participants may not view the activity as a serious learning exercise, threatening experimental realism. Participants may not recognize the learned skills that were necessary to succeed or be able to identify how the lack of those skills led to an obstruction in progress for the team. Therefore, an important step to making sure that this avenue to game-based learning is successful is to follow the escape room with a debriefing that outlines knowledge, skills, or attitudes that enabled the team to be successful (Dreifuerst, 2012). For instance, puzzles that require communication or pattern matching to succeed can be used to help people learn how to utilize these skills in other areas.

### *Limitations*

There are multiple limitations associated with the use of an escape room in team-based research. These limitations range from characteristics of the tasks that are mainly used (i.e. puzzles), to difficulties stemming from the creation and maintenance of the escape room. Fortunately, many of these issues can be resolved through prototyping escape rooms.

*Puzzles.* Escape rooms primarily rely on various puzzles as their main task sets. However, puzzles are certainly not representative of the variety of tasks teams in modern organizations face; therefore, assessments in an escape room might not capture the type of performance of equivalent organizational teams. Puzzles also require extensive a priori time investments to develop with each puzzle's difficulty being to challenging to ascertain until participants begin attempting the room. Considerations for escape room puzzles include making certain that puzzles are at the appropriate level of difficulty for the given number of team members and whether or not participants can actually complete each puzzle given the information present within the room.

*Time limits.* Escape rooms also typically impose a time limit for solving all puzzles. Such time limits could affect research studies and warrant consideration as time limits may not reflect actual team environments. Time limits also make it difficult to create experimental test beds. Researchers need to consider the tradeoffs between enforcing time restrictions and allowing teams to remain in the room until they give up or complete all the puzzles.

*Procedure standardization.* Procedure standardization can prove to be difficult with an escape room. Balance that must be maintained between ensuring the escape room requires no prior knowledge to complete successfully; while, simultaneously limiting any effects of a priori knowledge on team success concerning the escape room's puzzles (e.g. individual differences in problem solving ability). Verifying that data can be captured from the team's performance at all stages of the activity in the escape room is also essential to consider before beginning data collection. As an example, a puzzle that can be moved or hidden out of sight from a researcher or camera could lead to difficulty in assessment of performance in post-performance videos. Another procedure that must be standardized is resetting the escape room after each team participates. Prototyping must be done to ensure the reset intervals in the escape room's procedure are scheduled such that researchers are provided enough time to prepare the room for the next team.

*Unwanted behaviors.* Additionally, escape rooms can lead to behaviors that are not of interest to the research but can adversely affect the outcome (e.g., cheating). Participants will interpret clues for puzzles in unintended ways or approach puzzles with a different mindset than may be anticipated. If participants cannot solve a puzzle, they might attempt to surpass locks or objects through brute force. This necessitates vigilance on the researchers' part both in the creation of puzzles and in the observation of live teams. This could potentially be remedied through closed circuit cameras; however, this adds cameras another technological hurdle for a research team.

## **Conclusion**

Modern organizations are reliant on the successful performance of teams and are subsequently interested in interventions that can improve the performance of teams. Escape rooms are beginning to receive attention as an avenue to enhance teams; however, empirical research using escape rooms is limited. Additionally, using an escape room to conduct team-based research requires many considerations surrounding its development, avenues for data collection, and challenges associated with their use in research. Developmental considerations include issues such as identifying a theme, determining a location for the room and its size, the creation of multiple puzzles or challenges in the room and their corresponding hints, and the utilization of prototyping. The use of escape rooms as a testbed for team-based research caters to both observational and survey based data collection techniques and enables novel insights into team processes and performance through interactions of escape room elements with teamwork and problem solving. Escape rooms are not a methodological panacea, however, as their use in team-based research is accompanied by multiple challenges such as cheating behaviors, how to appropriately use and implement hints, as well as issues of standardization in resetting the room between trials.



## Declaration of Conflicting Interests

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

## Funding

The authors received no financial support for the research, authorship, and/or publication of this article.

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