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Theoretical Article

Planning an Escape: Considerations for the Development of Applied Escape Rooms

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Abstract

Background. Teams are essential to a wide array of applications and organizations often utilize varying interventions to improve the effectiveness of their teams. Due to their collaborative and modifiable characteristics, escape rooms are being increasingly utilized as an avenue to both deliver team interventions and to function as testbeds in research. Escape rooms are complex, interdependent activities which warrant careful planning to be effectively implemented. Despite the growing literature base concerning escape rooms, there is still limited practical guidance to inform the development of an escape room.

Aim. The purpose of this article is to provide seven considerations that are relevant to the development, implementation, and effectiveness of an escape room. Specifically, guidance is provided in determining the objectives, identifying a theme, assigning the roles, establishing participant interdependence, selecting a venue, designing the puzzles, and creating the assessments.

Conclusion. The considerations provided in this article can advance the science underlying the use of escape rooms and preclude difficulties associated with their use.

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escape room, methodology, development, team training, team building

Background

The importance of teams in modern organizations cannot be understated. Teams are critical assets in a variety of working environments such as commercial offices, the military, power plants, and hospitals (Driskell, Salas, & Driskell, 2018). As such, organizations have a vested interest in interventions which can improve the effectiveness of teams, such as team training or team building. Team training emphasizes the improvement of specific team competencies, while team building interventions seek to improve team dynamics (Lacerenza, Marlow, Tannenbaum, & Salas, 2018) or interactions between team members (Shuffler, DiazGranados, & Salas, 2011). In recent years, escape rooms have been increasingly utilized as a method to design and deliver team interventions (Anderson, Lioce, Robertson, Lopreiato, and Díaz, (2021).

Escape rooms are "live-action, team-based games where players discover clues, solve puzzles, and accomplish tasks in one or more rooms in order to accomplish a specific goal (usually escaping from the room) in a limited amount of time" (Nicholson, 2015, p. 1). Commercial escape rooms began in 2007 in the entertainment industry as a recreational activity in Japan (SCRAP, 2007) and have since seen a rapid expansion in popularity, as evidenced by the increasing number of commercial escape room businesses. Today, there are over 4,000 escape room businesses located in over 1,500 sites in 68 different countries (Dilek & Dilek, 2018) and these have expanded considerably in number, complexity, and scope in the intervening time. The modifiable nature of escape rooms and their puzzles make for an efficacious avenue for research, education, team training, and team building. Escape rooms provide opportunities to practice social and cognitive skills in a collaborative, safe, and replicable environment (Pan, Lo, & Neustaedter, 2017), and have been successfully utilized to improve collaboration skills (Friedrich, Teaford, Taubenheim, Boland, & Sick, 2019; Kutzin, 2019), foster team cohesion (Warmelink et al., 2017) as well as augment educational interventions in a variety of applied domains, such as computer security (Béguin et al., 2019), engineering (Borrego, Fernández, Blanes, & Robles, 2017), and healthcare (Diemer, Jaffe, Papanagnou, Zhang, & Zavodnick, 2019; Edwards, Boothby, & Succheralli, 2019; Zhang, Diemer, Lee, Jaffe, & Papanagnou, 2019; Frederick & Reed, 2021; Valdes, Mckay, & Sanko, 2021).

Escape rooms are an inherently complex and interdependent activity and require careful planning to be effectively implemented. Prior research has provided considerations for the application of escape rooms in teams research, focusing on research questions and research methodology that can be supported through an escape room testbed (Cohen et al., 2020). Other researchers have focused on educational applications of escape rooms, providing considerations that can inform activity and puzzle design to support the achievement of learning outcomes (Clarke et al., 2017; Eukel & Morrell, 2021). While

there are some suggestions for how to set up an escape room (e.g., Laerdal, n.d.; Sanders, Kutzin, & Strother, 2021), most suggestions are limited to a specific scenario or scattered across multiple accounts. As a result, there is little practical guidance available to inform the development and implementation of an escape room as a research testbed. Many questions remain unanswered concerning the logistics that underpin an escape room intervention; researchers, educators, program designers, and managers would significantly benefit from guidance on how to determine the characteristics of an escape room. Thus, the purpose of this article is to discuss considerations that are relevant to develop and implement an escape room. The considerations offered are largely intended for physical escape room development, but most of the same concerns hold for digital escape rooms as well.

Considerations for Escape Room Development

Consideration 1. Determine the Objectives

Identifying the purpose of an escape room is a critical first step in the design process, as the purpose of an escape room will inform design decisions that follow. There is a growing range of applications in which an escape room can be used as an intervention for teams of varying sizes. These applications include research, team building, team training, and education.

Research. Escape rooms are a useful testbed for performing teams research as the characteristics of an escape room activity like task interdependence or puzzle difficulty can be modified to emphasize different qualities among participant teams. These qualities, such as collaborative problem solving or effective communications, can be developed within the team while introducing time pressure within a safe and replicable environment (Cohen et al. 2020). Escape rooms can be used to study antecedents to teamwork, how these antecedents influence team members' cognitive and behavioral processes during the activity, and how these factors interact to culminate in team performance. For example, a study aiming to observe how team members communicate under stressful or time-limited conditions could utilize an escape room as a testbed by incorporating a variety of interdependent puzzles or challenges that require efficient communications between multiple team members to complete. Cohen et al. (2020) have provided a thorough discussion of considerations for researchers seeking to utilize escape rooms for teams research including some considerations related to the design of an escape room activity, how escape rooms can be utilized as teams research testbeds, as well as multiple challenges associated with the use of an escape room in research methodology. The Cohen et al. (2020) paper can help identify objectives for research, but there may be other goals for the escape room such as team building, team training, and education.

Team building and team training. Escape rooms can be used to facilitate team building by emphasizing variables related to teamwork such as cohesion, psychological safety, or

team efficacy. For example, Cohen et al. (2021) have demonstrated positive effects on perceptions of group cohesion among interdisciplinary healthcare teams resulting from a team-building escape room. In another case, a study of registered nurses and care assistants participated in an escape room and reported enjoyment, high satisfaction, and confidence in their ability to apply their knowledge to their clinical role (McLaughlin, Reed, Shiveley, & Lee, 2021). Since escape rooms reward effective problem solving in the form of progression through a room's tasks needed to escape, they can also be used to emphasize psychological safety within participant teams by reinforcing team members' tendencies to communicate openly or offer suggestions without fear of being penalized. This could be accomplished through careful feedback on attempted puzzle outcomes or team support through hint mechanics that may bypass or help minimize disagreements (McLaughlin et al., 2021). Additionally, each puzzle or challenge in an escape room serves as an opportunity to bolster teams' perceptions about the effectiveness of their ability to work together. As each puzzle is solved, teams are provided with evidence of their ability to work together towards a shared goal which can subsequently bolster positive perceptions of team efficacy.

Education. Puzzles in an escape room can also be modified to emphasize technical or non-technical skills and serve as an avenue to deliver education and team training interventions (Fotaris & Mastoras, 2019). Prior researchers have developed frameworks to guide the development of educational escape rooms (Clarke et al., 2017). The puzzles in educational or training-based escape rooms can be developed to emphasize knowledge, skills, or attitudes that are related to task completion in a single domain (i.e., technical or task competencies) or that generalize to interactions with teammates across multiple domains (i.e., non-technical or team competencies). For example, an educational escape room designed with the purpose of training entry-level nurses in the necessary technical competencies for treating a patient with diabetes could include diabetes-related knowledge, skills, or attitudes into the puzzles in an escape room such as calculating a correct dosage of insulin based on clues or props in the activity. A more concrete example can be seen in the study by Spears, Díaz, and Diaz (2021) that embedded legal implications of medically treating an unaccompanied minor into the core purpose of the escape room. Conversely, escape rooms can emphasize non-technical competencies by increasing the amount of task interdependence required to complete puzzles, such as simultaneous decoding of ciphers located at different physical locations in the activity. Given the team-based nature of escape rooms, measures of learning concerning technical or non-technical competencies can be assessed at either the individual level or the team level (i.e., whether specific participants or the participant team as a whole achieved the desired learning outcomes) depending on the goals of the organization conducting the activity.

After identifying the objectives for an escape room activity, the next step for developers to consider before conducting the activity is to determine whether the escape room will feature a consistent theme.

Consideration 2. Identify a Theme

Most commercial escape rooms have a theme that draws the attention of potential participants. While a theme is not required to conduct an escape room, it can bolster narrative components of the room and help to create a more immersive environment. A theme is established through a narrative prebrief before the escape room activity in addition to the decorations, music, lighting, clues, puzzles, and story used throughout an escape room. There is variability in how themed an escape room is, and most rooms can fall into one of four categories: 1. no theme at all; 2. theme without a narrative; 3. narrative only in the backstory and the goal of the room; 4. storytelling through puzzles (the most popular among commercial escape rooms; Nicholson, 2015). Having a theme can help escape room developers narrow down the types of clues and puzzles used, the environment or venue required, and the escape room goal or win-conditions. Escape room win-conditions can be categorized into three types: 1. escaping from a locked environment (e.g., a prison or locked basement); 2. solving a mystery (e.g., identify the murderer in a group of potential suspects or determine why an accident occurred); 3. accomplishing a task (e.g., defuse a bomb, conduct a rescue mission, or find a missing person). Escape room win-conditions will be determined by the venue or any requirements of the organization (e.g., if the organization prohibits locking participants in a space, solving a mystery or accomplishing a task may be a more appropriate escape room win-condition). See Figure 1 for an example of win-conditions and possible themes that can be used to enhance an escape room experience.

Consideration 3. Assign the Roles

In addition to determining the purpose and theme, room developers should consider the different types of team roles and responsibilities necessary for successfully developing and managing an escape room (see Figure 2). The major roles to consider include room developers, designers, game managers (Sanders et al., 2021), and confederates.

Notably, it is possible and often likely that one individual will take on multiple roles depending on their skill-level and experience. However, having a diverse group of team members with varying levels of expertise and experience can be useful, and probably necessary, for developing and implementing the escape room experience for participants. Additionally, roles that interact directly with participants, such as the game manager and confederates, should take care not to influence unduly the performance of the participants within the escape room as this may bias any data collected.

Consideration 4. Establish Participant Interdependence

Escape rooms inherently require significant interactions between multiple individuals. Participants must interact amongst themselves and with the game managers. How these interactions manifest largely depends upon whether individuals are co-located or remote. In
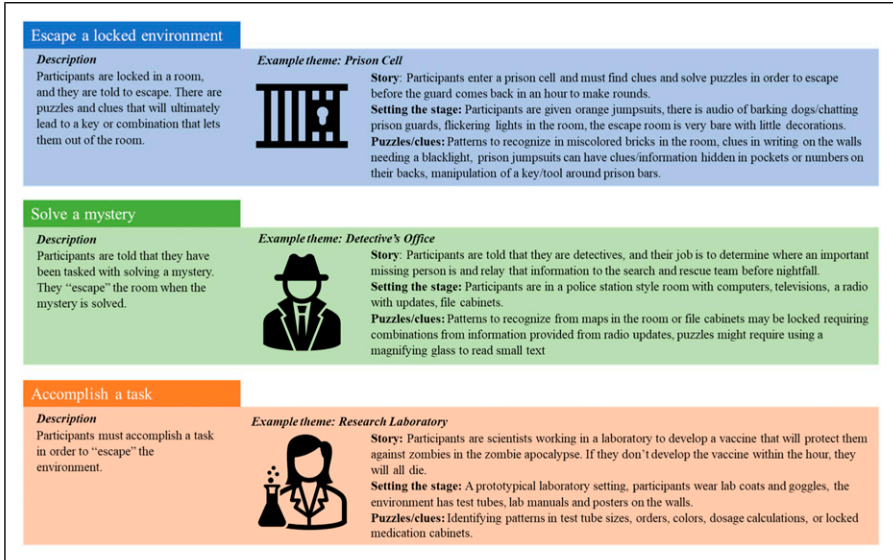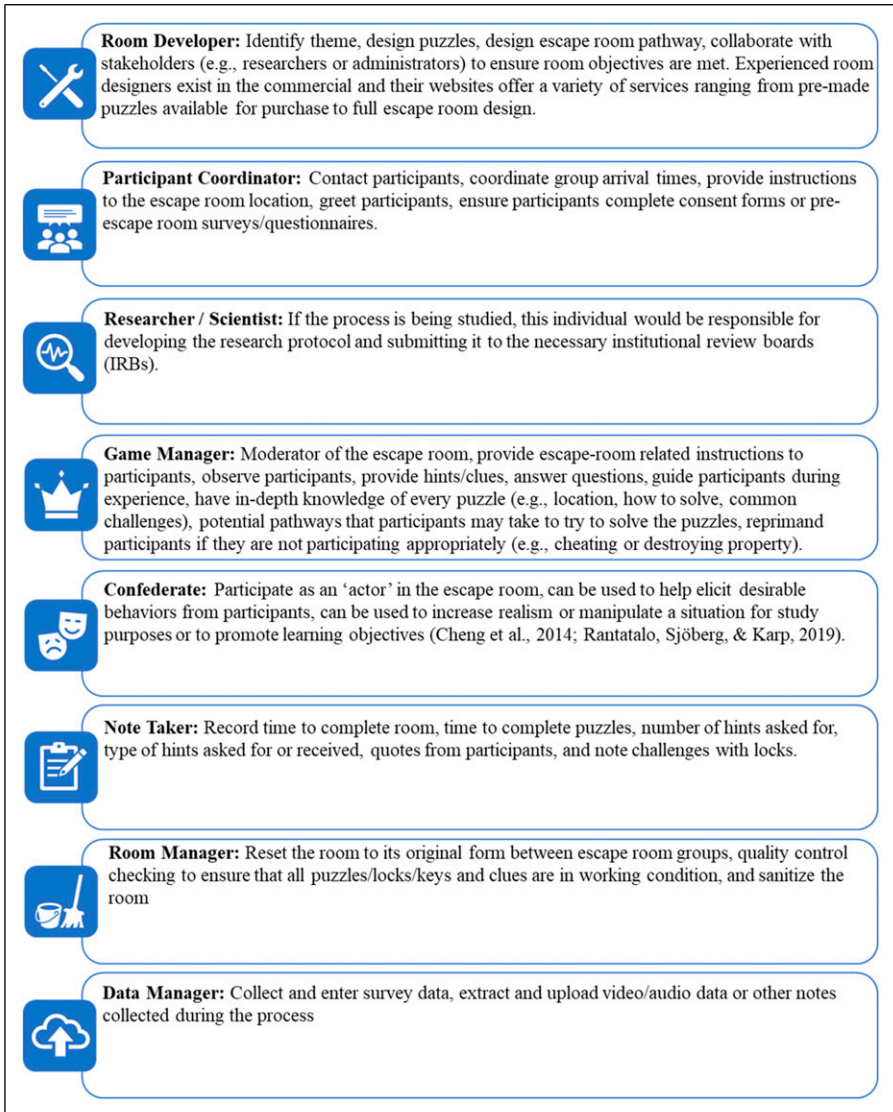
Figure 1. Examples of Room Win Conditions and Potential Themes.

other words, are the individuals in the same room, or are they working together virtually? Regardless of how these interactions arise, they are often rooted in interdependence.

Interdependence characterizes the level or sequence of actions by individuals necessary to complete a task or accomplish a goal (Campion, Medsker, & Higgs, 1993), and the source of interdependence can be multifaceted. That is, interdependence can be established by the desired goals, the manner in which individuals accomplish these goals, and even the actual task (Benishek & Lazzara, 2019). Formally defined, task interdependence is the extent to which individuals must rely on one another to perform their roles and responsibilities (Saavedra, Earley, & Van Dyne, 1993).

Task interdependence exists along a continuum of degrees of interaction ranging from lower degrees of interaction to higher, more intense degrees of interaction. From the lowest end of interaction, pooled interdependence occurs when each person contributes to the overall team without having to rely on other members or even interact directly with the other members. Sequential task interdependence is when each member must complete their task before another member is able to complete their respective tasks. Essentially, various parts of the overall task must be completed in a prescribed order. Because team members are reliant on one another, sequential task interdependence is considered to be slightly more intense compared to pooled interdependence. Following sequential task interdependence is reciprocal interdependence. Reciprocal interdependence occurs when individuals must have temporally lagged, two-way exchanges (i.e., members exchange tasks back-and-forth to one another). The

Room Developer: Identify theme, design puzzles, design escape room pathway, collaborate with stakeholders (e.g., researchers or administrators) to ensure room objectives are met. Experienced room designers exist in the commercial and their websites offer a variety of services ranging from pre-made puzzles available for purchase to full escape room design.

Participant Coordinator: Contact participants, coordinate group arrival times, provide instructions to the escape room location, greet participants, ensure participants complete consent forms or pre-escape room surveys/questionnaires.

Researcher / Scientist: If the process is being studied, this individual would be responsible for developing the research protocol and submitting it to the necessary institutional review boards (IRBs).

Game Manager: Moderator of the escape room, provide escape-room related instructions to participants, observe participants, provide hints/clues, answer questions, guide participants during experience, have in-depth knowledge of every puzzle (e.g., location, how to solve, common challenges), potential pathways that participants may take to try to solve the puzzles, reprimand participants if they are not participating appropriately (e.g., cheating or destroying property).

Confederate: Participate as an 'actor' in the escape room, can be used to help elicit desirable behaviors from participants, can be used to increase realism or manipulate a situation for study purposes or to promote learning objectives (Cheng et al., 2014; Rantatalo, Sjöberg, & Karp, 2019).

Note Taker: Record time to complete room, time to complete puzzles, number of hints asked for, type of hints asked for or received, quotes from participants, and note challenges with locks.

Room Manager: Reset the room to its original form between escape room groups, quality control checking to ensure that all puzzles/locks/keys and clues are in working condition, and sanitize the room

Data Manager: Collect and enter survey data, extract and upload video/audio data or other notes collected during the process

Figure 2. Escape Room Development – Team Member Roles and Responsibilities.

final, strongest level of task interdependence is team interdependence, which occurs when members jointly and actively collaborate to complete the overall task.

The type of task interdependence necessary is contingent upon a variety of factors. First, and perhaps most important, is that the desired level of interdependence is dependent upon the purpose of the escape room. For instance, if the escape room is

focusing on enhancing technical skills (e.g., the achievement of nursing competencies via the correct calculation of a drip-rate for a specific patient medication), then minimal interdependence may still accomplish the objectives. Conversely, if the purpose of the escape room is seeking to improve nontechnical skills, stronger interdependence may be necessary. For instance, a room that is seeking to investigate information exchange of unique knowledge between participants would require a room with significant levels of interdependence. Ultimately, there is no "incorrect" level of interdependence; however, there can be a mismatch between the desired objectives and the type of interdependence afforded by the room. Therefore, the type of task interdependence that is deemed most appropriate should be guided by pre-determined objectives.

Consideration 5. Select a Venue

Several factors should be considered when identifying a venue to host an escape room; importantly, one's ability to consider each of the factors discussed will depend heavily on the degree of funding available. When selecting a location for an escape room space, one should be aware of its proximity, accessibility, and security. If designing an escape room for research purposes, proximity to participants can be extremely important (Kaba & Beran, 2014), especially if the participants consist of company employees who will be completing the experience during work hours. The location should be accessible for both participants (e.g., providing free parking, transportation, and clear direction for how to access the space) as well as employees (e.g., 24/7 access for developing, building, setting up, and resetting the escape room). Accessibility also refers to the characteristics of your participants and their ability to both access and engage with the escape room. Considerations for disability access and group engagement for those with disabilities should be included as part of the escape room design. Moreover, given that the escape room will likely contain expensive equipment or identifiable participant information (e.g., recorded videos and survey responses), it is vital the location is secure with access (to the room, equipment, and data) provided only to necessary personnel.

With respect to the physical structure of the escape room, every room can differ in terms of its size as well as the number of rooms included. Both factors will be guided by the size of the venue, the ideal number of team members invited to participate, and the size and positioning of puzzles and tasks. Notably, adding multiple rooms to an escape room activity can increase the complexity of the room. In some cases, upon arrival in the escape room setting, participants will scan the room looking at the number of puzzles, clues and other relevant pieces of information and may base the timing of their decision-making on the number of puzzles they believe are remaining. However, when multiple rooms are included in the activity, participants may be surprised by unanticipated puzzles. Developing an escape room with multiple rooms will also require additional considerations on behalf of the game managers. For example, one should consider the ease of transition between rooms. Are the rooms self-contained (e.g., no items, puzzles or information are needed across rooms), or are they dependent upon one

another (e.g., clues, keys, puzzles, or information found or solved in one room are needed to progress in another room)? Digital escape rooms will likely differ from their physical counterparts in this consideration as they are not constrained in the same way by physical dimensions, but may instead have unique concerns involving technological implementation, operational error detection and correction, levels of achievable fidelity, and methods of team interaction as a result of the created venue. Some of these considerations can be seen in the article by Kutzin, Sanders, and Strother (2021) where development of an escape room was created in a virtual environment. Puzzle operation, team interaction, and facilitation of participants who are not physically co-located were included as specific deliberations when implemented in that non-physical space.

Consideration 6. Design the Puzzles

Central to escape room design is puzzle design, as these provide the obstacles needed to complete the objective of the exercise. The content of puzzles may be dependent upon a theme, but an essential consideration of all escape rooms is that puzzle design be considered for the goal of the room and the level of the participants. For example, in a training-focused room the content required to solve the puzzles should be contained within the room. If the proficiency to solve the puzzles is embedded within the participants, perhaps via previous training, then the room's puzzle design should carefully test those proficiencies.

Puzzles come in many formats. A list provided by Nicholson (2015) contains 31 examples of common puzzles frequently utilized in escape rooms, the most common being searching for physical objects hidden in the room, team communication, puzzles using light, and those requiring counting. While this list provided specific examples of puzzles, it did not discuss more general categories of puzzle types to consider. Table 1 provides a sample of typical puzzle categories with their characteristics and the type(s) of behavior needed to be successful in their solutions. Note that most of these puzzle types usually provide solutions that become the input to other puzzles or some other mechanism within the escape room itself. For example, number locks or word locks will take their solutions from numerical puzzles or word puzzles, respectively, to open the locks. An example of this can be seen in a study by Sarage, O'Neill, and Eaton (2021) where a crossword puzzle needed to be completed and the target word in the crossword was highlighted in blue within the crossword. That particular word was then used to open a word lock to allow the participants to proceed. Keys to open more traditional locks may be obtained by solving puzzles of any form; a puzzle can provide access to clues for other puzzles which, when solved, provide the information needed to access locked boxes or cabinets that, when opened, contain information needed to solve yet other puzzles.

Which category or categories of puzzles to use will depend largely on the purpose and theme of the room, available resources, desired behaviors, and the expertise of the participants. To elaborate with an example pertaining to resources, if game managers only have access to traditional locks, puzzles will need to provide information on how

Table 1. Puzzle Characteristics and Skills Needed for Success.

Puzzle Type	Characteristics	Examples	Skills for success
Sensory Puzzles	• Detection of details within the escape room environment – usually most commonly used puzzle type • Involves different visual characteristics of objects such as similarity of colors, shapes, or sizes between objects	• Counting puzzles (participants need to count the number of items within the environment to provide digits to a number lock) • Disparate items sharing similar color patterns that should be linked together • Providing participants with technology (e.g., UV lighting) to highlight a spectrum unavailable to their eye to reveal clues or details about other puzzles in the room • Involvement of other senses instead of sight (e.g., discriminating between smells, tastes, or textures)	• Perceptual discrimination • Careful selective attention to detail
Word Puzzles	• Obstacles that involve language elements at their core	• Riddles where participants must guess the answer to a question • Ciphers where some pattern is hidden within text via a letter substitution • The shape or representation of the words provides clues to a puzzle's solution • Includes things like anagrams, rebuses and crosswords	• Linguistic ability
Physical Puzzles	• Involves direct manipulation of objects	• Learning that a set of dice is loaded and always produces the same number after rolling them several times • Often includes an essential spatial component (e.g., jigsaw or tangram puzzles – smaller individual pieces must fit in a particular orientation within a larger border (e.g. map, or poster of a scene)	• Spatial ability • Physical dexterity
Numerical, Mathematical, and Logic Puzzles	• Contains logic elements to understand and complete the puzzles • Could involve understanding numerical relationships, such as ratios of numbers relative to each other, performing simple mathematical equations, or understanding implications of solutions on the basis of logical rules. All of these forms of puzzles require the participant to utilize critical thinking or mathematical ability to solve the puzzle	• Finding a clue that says "a+b = c; b+c=7" and along with the constraint that the values for a-c have to be different numbers, using simple math and logic would generate the values of a, b, and c as 1, 3, and 4, respectively	• Logical thinking • Mathematical ability

Table 1. (continued)

Puzzle Type	Characteristics	Examples	Skills for success
Social Dynamics puzzles	• Interactions with other participants are required to complete the puzzle • While information needs to be shared across all puzzles for escape room success, the key to this category is that the social interaction is the puzzle, rather than a by-product of knowledge sharing of other puzzle solutions	• Unique information is provided to key team members at the start of the escape room that they must recognize as important and share with others at the critical time • A confederate in the room must be asked appropriate questions to elicit key information to complete other puzzles, such as background information on a suspect that leads to the suspect's password	• Interpersonal communication skill • Metacognitive ability
Pattern-Matching Puzzles	• Catch-all – may involve other categories • Requires noticing a particular pattern within the format of information provided	• Highlighting certain words within a text passage involves words, but the more important element is recognizing that the highlighted words spell a phrase, rather than the words themselves • This category also includes puzzles such as matching musical sequences to a pattern or comparisons of objects to discover which objects are different from the others based on critical details	• Abstract reasoning

to obtain the keys. When possible, however, game managers should strive for a wide array of puzzle types, rather than utilizing only one type repeatedly throughout the room. Regarding desired behaviors, consideration of trained or assessed behavior is important, such as using puzzles that enhance team coordination or evaluate observation of perceptual details. Finally, concerning the expertise of the participants, game managers should give some consideration regarding the difficulty of puzzles and when they are to be solved within the room. That is, it is beneficial to have puzzles with easier or more obvious solutions early in the room to promote engagement with participants before they interact with more complex puzzles further in the sequence of solutions to escape the room.

Consideration 7. Create the Assessments

Because the quality of data within a research endeavor is of paramount concern, it is imperative that room developers scrutinize how the escape room participants will be observed. When finalizing the observation plan, there are important elements to consider.

One element to consider is the location of the observers. Observation can be conducted by confederates in the escape room or from a separate physical space (either with an observation window or via cameras). Observers within the room may be better able to identify who is speaking or interpret facial expressions than those externally

located. However, participants completing the escape room may alter their behaviors since they are cognizant they are being observed. Observers in another room are potentially less likely to influence participants' behaviors, but it may be more difficult for them to identify speakers and facial expressions. Having observers in another room necessitates the use of audio/visual equipment. When thinking about the audio/visual equipment, it is important to determine relevant features such as camera definition, zoom capabilities, tracking options, or lens angle in addition to the location of the equipment and the amount of equipment necessary. The available features to be captured such as facial expressions may dictate the type of data that can be acquired. The location of the equipment will determine if there are dead zones (i.e., areas of the room that are unobservable or that are not being recorded), and the amount of equipment will be related to how many displays need to be monitored by game managers or how many feeds would need to be spliced together by editors.

Another element to consider is whether the observations will occur in real-time or after the escape room via video recordings. Real-time observations have the advantage of acquiring data quickly; however, observers are more likely to unintentionally miss behavioral data if behaviors are happening rapidly or by many individuals simultaneously. Video-recordings require substantial post-processing that delays the time to reach data analysis. On the other hand, video-records have the potential for more accurate data capture; recordings can be manipulated to ensure the data is acquired correctly (e.g., the video can be rewound or the footage can be played at slower speeds).

A final element to consider for assessment involves data collection from participants upon their completion of the escape room. A debrief of the participant's experience can provide key data regarding the enhancement and learning of the participant from the experience (Tannenbaum & Cerasoli, 2013). Additionally, reflection of escape room participation can help expand understanding of behavior observed during the escape room exercise, provide feedback about the escape room and puzzle construction, and subjective perceptions from participants about the overall experience. These data become important because they are assessments that can only be obtained once the escape room has been concluded.

Each of these factors have multiple options that need careful scrutiny, and the permutation and assessment that is employed is contingent upon the purpose of the room. For example, if the purpose of the escape room is for research, the careful collection of data from participants remotely without influence is important. If the purpose of the escape room is for team building or team training, care in the selection of puzzles to enhance technical or non-technical skills and real-time support for participants may be paramount. For escape rooms with an educational purpose, the development of an educational protocol and review of the learning objectives by participants in a post-event analysis may be most important. That is, the purpose of the room is arguably the main driving force behind many of these decisions. Each element and each option has their own respective advantages and disadvantageous, so aligning the purpose of the room along with any practical constraints will largely inform what is deemed most appropriate.

Limitations and Future Directions

The considerations outlined here are intended to aid in deliberations for the creation of escape rooms for research. One limitation is that these considerations have not been validated through empirical support, but instead are a set of lessons learned through escape room development. Therefore, one future direction includes experimental assessment of the considerations and their value to escape room construction. A second direction involves testing the generalizability of these considerations to different domains and applications. Third, another future effort involves the comparison of digital versus physical venue impacts on escape room implementations. These future works can help strengthen the utility of these considerations for the design of escape rooms for research.

Conclusion

Teams are vital to the success of countless industries. Organizations are, therefore, interested in team interventions which can bolster the effectiveness of teams. Escape rooms are being increasingly utilized in team intervention methods, but guidance to inform their development and best practices for conducting an escape room are sparse in the literature. To address this gap, seven considerations were provided that are relevant in developing the implementation of an escape room: 1. determining the objectives; 2. identifying a theme; 3. assigning the roles; 4. establishing participant interdependence; 5. selecting a venue; 6. designing the puzzles; and 7. creating the assessments. The considerations provided in this article were assembled with the goal of advancing the science underlying the use of escape rooms in research.

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References

Anderson, M., Lioce, L., Robertson, J. M., Lopreiato, J. O., & Díaz, D. A. (2021). Toward defining healthcare simulation escape rooms. *Simulation & Gaming*, *52*(1), 7-17. https://doi.org/10.1177/1046878120958745

Béguin, E., Besnard, S., Cros, A., Joannes, B., Leclerc-Istria, O., Noel, A., Roles, N., Taleb, F., Thongphan, J., Alata, E., & Nicomette, V. (2019). Computer-security-oriented escape room. *IEEE Security & Privacy*, *17*(4), 78-83. https://doi.org/10.1109/MSEC.2019.2912700

Benishek, L. E., & Lazzara, E. H. (2019). Teams in a new era: Some considerations and implications. *Frontiers in Psychology*, *10*(1006), 1-15. https://doi.org/10.3389/fpsyg.2019.01006

Borrego, C., Fernández, C., Blanes, I., & Robles, S. (2017). Room escape at class: Escape games activities to facilitate the motivation and learning in computer science. *Journal of Technology and Science Education*, *7*(2), 162-171. https://doi.org/10.3926/jotse.247

Campion, M. A., Medsker, G. J., & Higgs, A. C. (1993). Relations between work group characteristics and effectiveness: Implications for designing effective work groups. *Personnel Psychology*, *46*(4), 823–847. https://doi.org/10.1111/j.1744-6570.1993.tb01571.x

Cheng, A., Auerbach, M., Hunt, E. A., Chang, T. P., Pusic, M., Nadkarni, V., & Kessler, D. (2014). Designing and conducting simulation-based research. *Pediatrics*, *133*(6), 1091-1101. https://doi.org/10.1542/peds.2013-3267

Clarke, S., Peel, D. J., Arnab, S., Morini, L., Keegan, H., & Wood, O. (2017). escapED: A framework for creating educational escape rooms and interactive games for higher/further education. *International Journal of Serious Games*, *4*(3), 73-86. https://doi.org/10.17083/ijsg.v4i3.180

Cohen, T. N., Griggs, A. C., Kanji, F. F., Cohen, K. A., Lazzara, E. H., Keebler, J. R., & Gewertz, B. L. (2021). Advancing team cohesion: Using an escape room as a novel approach. *Journal of Patient Safety and Risk Management*, *26*(3), 126-134. https://doi.org/10.1177/25160435211005934

Cohen, T. N., Griggs, A. C., Keebler, J. R., Lazzara, E. H., Doherty, S. M., Kanji, F. F., & Gewertz, B. L. (2020). Using escape rooms for conducting team research: Understanding development, considerations, and challenges. *Simulation & Gaming*, *51*(4), 443-460. https://doi.org/10.1177/1046878120907943

Diemer, G., Jaffe, R., Papanagnou, D., Zhang, X. C., & Zavodnick, J. (2019). Patient safety escape room: A graduate medical education simulation for event reporting. *MedEdPORTAL*, *15*. 10868, https://doi.org/10.15766/mep_2374-8265.10868

Dilek, S. E., & Dilek, N. (2018). Real-life escape rooms as a new recreational attraction: The case of Turkey. *Anatolia*, *29*(4), 495-506. https://doi.org/10.1080/13032917.2018.1439760

Driskell, J. E., Salas, E., & Driskell, T. (2018). Foundations of teamwork and collaboration. *American Psychologist*, *73*(4), 334-348. https://doi.org/10.1037/amp0000241

Edwards, T., Boothby, J., & Succheralli, L. (2019). Escape room: Using an innovative teaching strategy for nursing students enrolled in a maternity clinical course. *Teaching and Learning in Nursing*, *14*(4), 251-253. https://doi.org/10.1016/j.teln.2019.05.001

Eukel, H., & Morrell, B. (2021). Ensuring educational escape-room success: The process of designing, piloting, evaluating, redesigning, and re-evaluating educational escape rooms. *Simulation & Gaming*, *52*(1), 18-23. https://doi.org/10.1177/1046878120953453

Fotaris, P., & Mastoras, T. (2019, October). *Escape rooms for learning: A systematic review.* [Paper presentation]. Proceedings of the 2019 13th Annual European Conference on Games Based Learning, Odense, Denmark. https://doi.org/10.1111/bjet.12935

Frederick, A. N., & Reed, J. A. (2021). Operation outbreak: A Periop 101 exam review escape room. *Simulation & Gaming*, *52*(1), 88-95. https://doi.org/10.1177/1046878120948922

Friedrich, C., Teaford, H., Taubenheim, A., Boland, P., & Sick, B. (2019). Escaping the professional silo: An escape room implemented in an interprofessional education curriculum. *Journal of Interprofessional Care*, *33*(5), 573-575. https://doi.org/10.1080/13561820.2018.1538941

Kaba, A., & Beran, T. (2014). Twelve tips to guide effective participant recruitment for interprofessional education research. *Medical Teacher*, *36*(7), 578-584. https://doi.org/10.3109/0142159X.2014.907489

Kutzin, J. M. (2019). Escape the room: Innovative approaches to interprofessional education. *Journal of Nursing Education*, *58*(8), 474-480. https://doi.org/10.3928/01484834-20190719-07

Kutzin, J. M., Sanders, J. E., & Strother, C. G. (2021). Transitioning escape rooms to a virtual environment. *Simulation & Gaming*, *52*(6), 796-806. https://doi.org/10.1177/10468781211035171

Lacerenza, C. N., Marlow, S. L., Tannenbaum, S. I., & Salas, E. (2018). Team development interventions: Evidence-based approaches for improving teamwork. *American Psychologist*, *73*(4), 517-531. https://doi.org/10.1037/amp0000295

Laerdal. (n.d.). *Simulation escape room resources*. https://www.laerdal.com/us/learn/simulation-escape-room-resources/

McLaughlin, J. L., Reed, J. A., Shively, J., & Lee, S. (2021). Escape room blueprint: Central orientation contagion crisis. *Simulation & Gaming*, *52*(1), 24-30. https://doi.org/10.1177/1046878120954493

Nicholson, S. (2015). *Peeking behind the locked door: A survey of escape room facilities* [White paper]. Wilfrid Laurier University. http://scottnicholson.com/pubs/erfacwhite.pdf

Pan, R., Lo, H., & Neustaedter, C. (2017, June). *Collaboration, awareness, and communication in real-life escape rooms*. [Paper presentation]. Proceedings of the 2017 Conference on Designing Interactive Systems, Edinburgh, United Kingdom. https://doi.org/10.1145/3064663.3064767

Rantatalo, O., Sjöberg, D., & Karp, S. (2019). Supporting roles in live simulations: How observers and confederates can facilitate learning. *Journal of Vocational Education & Training*, *71*(3), 482-499. https://doi.org/10.1080/13636820.2018.1522364

Saavedra, R., Earley, P., & Van Dyne, L. (1993). Complex interdependence in task-performing groups. *Journal of Applied Psychology*, *78*(1), 61–72. https://doi.org/10.1037/0021-9010.78.1.61

Sanders, J. E., Kutzin, J., & Strother, C. G. (2021). Escape the simulation Room. *Simulation & Gaming*, *52*(1), 62-71. https://doi.org/10.1177/1046878120963591

Sarage, D., O'Neill, B. J., & Eaton, C. M. (2021). There is no I in escape: Using an escape room simulation to enhance teamwork and medication safety behaviors in nursing students. *Simulation & Gaming*, *52*(1), 40-53. https://doi.org/10.1177/1046878120976706

SCRAP. (2007, July 7). *Real Escape Game project first series*. SCRAP. http://realdgame.jp/event/nazotokinoutage.html

Spears, S., Díaz, G. M., & Diaz, D. A. (2021). A community pediatric camp escape room: An interactive approach to applying real-life critical thinking skills. *Simulation & Gaming*, *52*(1), 31-39. https://doi.org/10.1177/1046878120972741

Shuffler, M. L., DiazGranados, D., & Salas, E. (2011). There's a science for that: Team development interventions in organizations. *Current Directions in Psychological Science*, *20*(6), 365-372. https://doi.org/10.1177/0963721411422054

Tannenbaum, S. I., & Cerasoli, C. P. (2013). Do team and individual debriefs enhance performance? A meta-analysis. *Human Factors*, *55*(1), 231-245. https://doi.org/10.1177/0018720812448394

Valdes, B., Mckay, M., & Sanko, J. S. (2021). The impact of an escape room simulation to improve nursing teamwork, leadership and communication skills: A pilot project. *Simulation & Gaming*, *52*(1), 54-61. https://doi.org/10.1177/1046878120972738

Warmelink, H., Mayer, I., Weber, J., Heijligers, B., Haggis, M., Peters, E., & Louwerse, M. (2017, October). *AMELIO: Evaluating the team-building potential of a mixed reality escape room game*. [Paper presentation]. Proceedings of the Annual Symposium on Computer-Human Interaction in Play, Amsterdam, Netherlands. https://doi.org/10.1145/3130859.3131436

Zhang, X. C., Diemer, G., Lee, H., Jaffe, R., & Papanagnou, D. (2019). Finding the 'QR' to patient safety: Applying gamification to incorporate patient safety priorities through a simulated 'escape room' experience. *Cureus*, *11*(2). e4014, https://doi.org/10.7759%2Fcureus.4014

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