Can Low Fidelity Tabletop Games be used to Improve Teamwork?

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ABSTRACT

Results are presented from the I/ITSEC 2024 workshop (From the Last of Us to the First of Us – Rebuilding after a Zombie Crisis Phase II) and a workshop conducted with employees of the Hope Research Center (HRC) at the Defense Equal Opportunity Management Institute (DEOMI). Players built on decisions made by I/ITSEC 2023 workshop participants during crisis events in the first month following the collapse of civilization; a year has passed, and participants must thrive and survive. Time-restricted scenarios required teams to make decisions that affected their ability to prosper within the zombie threat and determine who to trust and how much risk to assume while focusing on rebuilding civil society. For 2024, the 2023 Table-Top/Live Action Role Playing Game was modified with card game features that required players to rapidly develop and manage resources, form leader and job roles, negotiate, prioritize critical information, attempt risk mitigation strategies, generate solutions, and engage in short and long-term planning while incorporating moral/social anxiety. Perceived game confidence, team cohesion, team efficacy, team process, and game reactions were assessed. In addition, observed team processes were assessed using a tablet loaded with the Generalized Intelligent Framework for Tutoring (GIFT) system. Audio/video recordings of gameplay were collected, and a midpoint and final After-Action Review (AAR) were conducted. As in 2023 the game received very positive reviews. Post-game cohesion and team efficacy were significantly more positive, and post-game team process attitudes improved, possibly because teams remained mostly intact with only a few departing to become zombie horde managers. We verified that teamwork could be observed and assessed, with teams performing mostly at or above expectations throughout the game. We verified that teamwork behavioral markers could be identified via audio recordings that automatically analyzed key word phrases for teamwork. Lessons learned and recommendations for future research are discussed.

ABOUT THE AUTHORS

Joan Johnston, PhD., has over 3 decades of experience as a military research psychologist. She developed and led award winning research on training effectiveness, team training, and training technologies at the Naval Air Warfare Center Training Systems Division, and the U.S. Army DEVCOM SC, STTC. Dr. Johnston collaborated on and authored over 80 publications and presentations on these topics. She currently works for the Alaka'ina Foundation. She received her M.A. and Ph.D. in Industrial and Organizational Psychology from the University of South Florida.

Grant Johnston received a bachelor's degree in Sociology from the University of Florida**.** As a research assistant, he has participated in the development, implementation, and analysis of the I/ITSEC 2023 and 2024 zombie workshops.

Lisa N. Townsend, MS., is a Senior Research Psychologist at the U.S. Army DEVCOM SC, STTC. She has an M.S. in Industrial/Organizational Psychology and a B, A. in Psychology, from the University of Central Florida (UCF). She has worked on many diverse teams including those within Research and Development, Technology Transfer, Instructional Systems Design, and Human Systems Integration. Ms. Townsend's areas of expertise involve team training, Front End Analysis (FEAs), Training Systems Analyses (TSAs), Instructional Systems Design (ISD),

Training Effectiveness Evaluations (TEEs), and the development of training and organization related metrics. Her efforts in these areas have spanned across Services and platforms.

Jerry R. Mize, MA., was a Program Analyst for the U.S. Army DEVCOM SC, STTC since October 2019 and formerly a 28-year Army Veteran working in Special Operations, Communications, Military Intelligence, Air Defense, and Acquisition. He held an Associate of Applied Science in Electronics, a BS in Technology, and a MA in Acquisition and Procurement. He worked in varied tactical and strategic positions conducting warfighting and administration, particularly in Operational Planning and Exercises, served as instructional faculty at Jacksonville State University, and was a published author. At STTC he worked with research teams in simulation and training research to link personal interests, military knowledge and practices to improve research and development products.

Tami Griffith, PhD., worked as a Chief Engineer with the U.S. Army DEVCOM SC, STTC for 30 years, then worked as the Deputy Director for the Hope Research Center at the Defense Equal Opportunity Management Institute (DEOMI). She completed her PhD in Engineering Modeling & Simulation from University of Central Florida (UCF). She has worked on both the technical and programmatic side of training system acquisition at the U.S. Army Program Executive Office, Simulation Training and Instrumentation (PEO STRI) as well as on cutting edge research in support of training technology at CCDC, SC, STTC.

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INTRODUCTION

Crisis management involves taking effective actions to identify, assess, and respond to crises (Di Loreto, et al., 2012). Teamwork and team leadership play a critical role in managing performance during unfolding, ambiguous, and dangerous crisis situations (e.g., military missions and emergency management) (Johnston et al., 2019). Teams with higher levels of team cohesion and team efficacy are better at engaging in teamwork processes and team task performance and are thus more resilient in managing stress (Elms et al., 2022; Johnston & Patton, 2022; Mathieu et al., 2019; Sottilare et al., 2018). Stress Exposure Training, incorporating simulations with task-relevant, time critical events, increasing stress levels, team assessments, and team-self correction in after action reviews (AARs), is an effective approach to building resilient crisis-management teams (Johnston et al., 2019). However, such training can be a prohibitive cost for the many government and non-government agencies that are key to successfully managing crises (e.g. hurricanes, floods, school shootings, etc.). Nevertheless, these organizations should have greater access to low-cost training for stress resilience. An important research finding is that teamwork skills are transportable to other tasks and job domains (Salas et al., 2018) and can be learned by playing low fidelity, low cost, interactive games (e.g., Edwards et al., 2023). Therefore, we planned and conducted a multi-year study to understand how to expand access to learning teamwork skills by creating and conducting a Table Top Role Playing Game (TTRPG) with Live Action Role Playing elements at the I/ITSEC 2023 (Year 1) and I/ITSEC 2024 (Year 2) workshops, and at the invitation of the Hope Research Center (HRC) Directorate of the Defense Equal Opportunity Management Institute (DEOMI) at Patrick Space Force Base, in Florida.

In Year 1, using zombies as the antagonist during a civil infrastructure collapse (Laine & Lindberg, 2020), we successfully demonstrated important game motivators (e.g., challenge, competition, and fantasy) and Stress Exposure Training design features (e.g., multiple, inter-related, and time dependent problems, unpredictable game outcomes, surveys, and real-time coaching and assessment with AARs) (Aggrawal & Boowuo, 2023; Chang et al., 2015; Di Loreto, et al., 2012; Townsend et al., 2024). We expected I/ITSEC participants to be an excellent source of subject matter expertise because they self-selected into the workshop and were a relatively homogeneous group employed in an industry that values teamwork, training, and using serious games for training, and attends I/ITSEC to learn and exchange ideas. Likewise, the HRC DEOMI participants were excellent subject matter experts because their mission, as a joint military activity agency, is to conduct research, training, and consultation programs to "foster behaviors and practices that enhance leadership and increase teamwork and unit cohesion across the Department of Defense" (https://www.deomi.mil). Therefore, we anticipated most participants would arrive with a baseline of and appreciation for teamwork skills that would be applied during gameplay.

Despite being ad hoc teams, Year 1 participants had strong positive feelings of team cohesion and team efficacy before and after gameplay, and pre-game cohesion and efficacy were significantly associated with higher levels of post-game team cohesion, team efficacy, and confidence. These results were similar to Johnston et al. (2019) who reported mostly intact, experienced US Army squads had strong relationships between team cohesion and team efficacy before (r =

.83) and after (r = .79) training. During the Year 1 Zombie Workshop examples of leadership and teamwork behaviors were directly observed but not evaluated (see Townsend et al., 2024 for details).

Motivated by these findings and recommendations for game improvements, a revised game was developed to advance our research goal of determining whether a low fidelity TTRPG could be used to improve observable teamwork and team leader behaviors (Ratwatte et al., 2025; Wang & Huang, 2021). The Year 1 game was modified to introduce increased socio-economic and organizational stability, while incorporating features that would trigger teamwork interactions (Aggrawal & Boowuo, 2023). We expected to see the same results for confidence, team cohesion, and team efficacy in the Year 2 and HRC DEOMI groups. The Year 1 measurement framework was expanded to include a survey of teamwork processes as previous research reported strong correlations of pre- (r = .67) and post-training (r = .76) team processes with pre-training team cohesion, and pre- (r = .75) and post-training (r = .80) team processes with pre-training team efficacy (Johnston et al., 2019). AAR implementation was improved and assessed with an AAR climate survey based on previous research reporting moderate relationships of AAR climate with cohesion (r = .46), efficacy (r = .55), and process (r = .45) (Johnston et al., 2019). We expanded utilization of the Generalized Instructional Framework for Tutoring (GIFT) system (Sinatra, 2018) to establish whether teamwork behaviors could consistently be observed and assessed and tested a speech-to-text technology to analyze player audio recordings to advance the ability to automatically categorize team behaviors. In this paper we present our findings and provide lessons learned and recommendations for future studies.

APPROACH

Game Development

Participants (players) in Year 1 experienced five consecutive one-day events very soon after the collapse (around 20 days). To survive, players had to work in small groups within buildings on a shared street. A year after the collapse of society, the Year 2 players joined established, specialized settlement locations (power plant, farming outpost, hospital and research facility) that had acquired some socio-economic stability. Four consecutive time-restricted scenarios, each representing a one-week period, required teams to make critical decisions to survive and prosper within the omni-present zombie threat, contending with who to trust and how much risk to assume as they focused on rebuilding civil society. Table 1 lists weekly events and goals. To reinforce cooperative play and challenge players to make trade-offs in how they applied their resources, card game mechanics encouraged players to work as a team to rapidly develop and manage resources, form leader and job roles, negotiate, prioritize critical information, attempt risk mitigation strategies, generate solutions, and engage in short and long-term planning. At game start each location contained an existing set of resident "Survivors" represented by cards showing their skill level and any unique talents. Players applied their Survivors to certain tasks over time to achieve goals and/or build capabilities and resources. Other resources such as sustenance, fuel, medical supplies and tradable goods were sought and supported by the Survivors. Players had to provide Survivors a weekly sustenance (food and water) to ensure their survival and support their ability to apply effort to achieve tasks or improve their defense and other capabilities, otherwise they would be unable to work and contribute and ultimately would perish, thus contributing to the zombie hordes. Fuel was provided for the use of vehicles or tools to optimize effort, and medical supplies were available to treat injuries. Each location was rich in specific resources but had deficits in others – providing reasons for building relationships with other groups, establishing trust, taking risks, and negotiation. With effort, players could generate a small quantity of needed resources. Additionally, a player could take Survivor cards and tradable goods to other locations to exchange for needed goods or scavenge for resources enroute, but the risk of zombie hordes threatened safe travel outside locations.

Compared to Year 1, much less physical live action occurred between zombies and players, instead this friction was managed through card game features. For example, vehicles could provide some protection moving between locations, but zombies could attack players and goods would be lost. Survivors who died within a location became zombies. They could be destroyed (with effort), or their numbers could accumulate in storage; if the number of stored zombies reached five, they broke out and became another horde with one of the players becoming a zombie horde manager and leaving the location. Zombies could wander from location to location testing the strength of defenses or attacking survivors between locations. When zombies attacked, the fate of the zombies and the survivors was determined through a roll of the dice based on the number of survivors and zombies engaged in combat. At the end of each event, players had to tally accumulated resource gains against losses to determine whether they had met the

event goals, whether players would expire and become zombies, and whether existing zombies would accumulate. The team's results from each event were tied to the next event which required advance planning and decision making.

Table 1. Weekly Event Triggers, Goals, and Decision Time.

Week 1: Move the Tree!	Week 2: Building Local Alliances NOW!	Week 3: Hurricane!	Week 4: Pandemic!
Due to damage from a hurricane last season, a huge oak tree surrounded by impenetrable debris has cut your group off from the rest of the world. Completing this task will aid in learning game mechanics and provide an avenue to scavenge for needed resources, explore other locations, and meet other Survivor communities. **Decision Time!** Will you move the tree?	New Survivors have arrived that want to join your group, and a Survivor has become a zombie **Decision Time!** • Will you accept the new people? • What will you do with the body of the individual who perished?	This week there was a horrible storm with hurricane force winds and torrential rain. There was flooding but the waters are beginning to recede from the roads. Roll 1 die to determine the level of damage sustained. **Decision Time!** • How will you address the damage toll? • Did anyone perish? What will you do with the bodies of the dead?	What started off with one or two people not feeling well has grown into a life-threatening outbreak! 5 people at your location have become very ill. One has already perished and became a zombie. The rest will recover if you have either medicine or a doctor at your location. Remember - Survivors who are ill become unable to work during recovery. Additionally, 5 Survivors have asked to join your location. **Decision Time!** • Will you accept the new people? • What will you do with the dead body?

Assessment Methods

Surveys

- **Demographics –** demographics questions included gender, race, job experience, game experience, game interests, and whether participants knew anyone at the workshop.
- **Game Confidence** - a four-item scale asked how confident participants felt about playing the game.
- **Team Cohesion** - a six-item, 1 to 5 Likert-type scale asked the degree of agreement with statements that asked how close they thought their team was during the mission just completed.
- **Team Efficacy** - a seven-item, 1 to 5 Likert-type scale asked the degree of agreement with statements about how confident the team was in its ability to successfully perform and to complete future missions together.
- **Team Process** – an eleven-item,1 to 5 Likert-type scale asked the degree of agreement with statements about how well the team members coordinated and communicated with each other.
- **AAR Climate** - an eight-item, 1 to 7 scale asked the degree to which the AAR was, for example, more open or closed, united or divided, and authoritative or participative.

Year 2 findings for team measures and AAR climate (See Table 3) indicated excellent internal consistency reliability estimates similar to Year 1 (Townsend et al., 2024) and Johnston et al. (2019).

Teamwork

Observer Ratings

Teamwork competencies assessed were:

- **Mutual Trust** - "A shared belief that team members will perform their roles and protect the interests of the team" (p. 1582, Baker et al., 2005).
- **Backup Behavior** - "Ability to anticipate other team member's needs through accurate knowledge about their responsibilities" (p. 276, Smith-Jentsch et al., 1998).

- **Initiative/Leadership** - "Ability to direct and coordinate the activities of other team members, assess team performance, assign tasks, motivate team members, plan and organize, and establish a positive atmosphere" (p. 1582, Baker et al., 2005).
- **Information Exchange** - "Effective exchange of information among team members allows the team to develop and maintain a shared situation awareness" (p. 276, Smith-Jentsch et al., 1998).

An event-based measurement technique was used that linked expected teamwork behaviors to trigger events within the game scenarios. It provided more opportunities for team members to learn effective team behaviors and enabled an objective approach to observing and assessing teamwork (Townsend, 2024). Three expected behavioral markers for each competency were aligned with a specific objective assigned for each scenario (week). The data were imported into GIFT and then downloaded onto observer tablets so that ratings could automatically be linked to a GIFT domain knowledge file (DKF) that was configured, connected and aligned to the external training application (i.e., the workshop) (Goldberg et al., 2020). Observers used the GIFT Game Master Interface and Observer Assessment Screen (See Figure 1) on the tablet to rate teams as Poor, Satisfactory, or Exemplary on expected behaviors aligned to one of the four competencies for each scenario (Sinatra, 2018). Rating results were tabulated and scrubbed after the workshop. Observers using a tablet and collecting data electronically is a method that has proven more efficient in observable behavior data collection efforts (Johnston et al., 2019; Townsend et al., 2017). This was a lesson learned from Year 1 when a paper-based assessment method was used as discussed in Townsend et al. (2024).

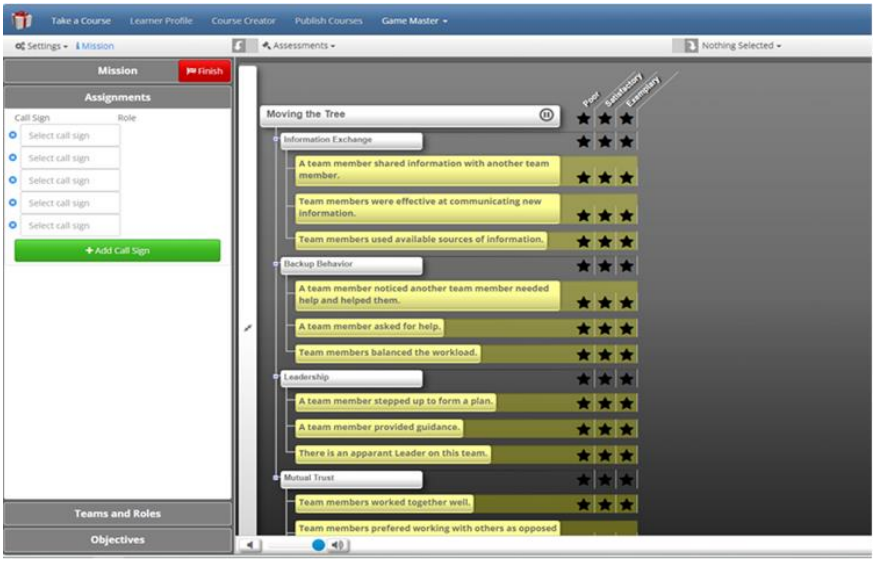

Figure 1: GIFT Game Master Observer assessment screen for Moving the Tree task.

Gameplay Content Analysis

An exploratory content analysis was conducted on game play communications to identify behavioral markers of expected teamwork behaviors (a full analysis of the transcripts collected from each location and the AAR was beyond the scope of this paper). Transcripts of team audio/video recordings were automatically generated using the Team Dynamics Measurement System technology (TDMS) that categorized a team member's dialog turn to produce who said it, the type of dialog turn made (i.e., a prompted update, or unprompted update, request for an update, unprompted clarification, requested clarification, stating a goal, closing a loop, or other type of communication), and a transcription of the communication (Avancha et al., 2024).

Game Reactions
Open ended questions asked participants to comment on whether they became a zombie, enjoyed the game, saw themselves as taking on various types of roles (i.e., as advancing new ideas, supporting, coordinating, and observing), could trust their own team and the other teams, used teamwork behaviors and team self-correction AARs on the job, would recommend game modifications and/or improvements.

Procedure

Prior to conducting the workshops, the DEVCOM Soldier Center provided a Human Subjects Research Determination (23-011) approving the study. As participants signed into the workshop they were provided with a survey booklet, assigned an identification number, and requested they not write their names to protect their identity. Prior to game start participants completed the demographic questions and game confidence survey. Next, they participated in a 30-minute tutorial presentation and then were introduced to the four team competencies. Players then chose one of four locations, discussed workshop objectives with the table game manager, practiced gameplay during the Week 1 familiarization scenario, and then completed the Pre-Game surveys for team cohesion, team efficacy, and team processes. The game officially began with the second scenario; followed with the team assessment, observer led mini-AAR providing feedback, coaching, and solicited feedback from team members regarding the competencies of information exchange and initiative/leadership. The AAR dialog prompts encouraged the teams to focus on a scenario trigger, discuss behavioral reactions, identify potential solutions, and then assess the consequences of actions and non-actions. After the fourth scenario, participants completed Post-Game confidence, team cohesion, team efficacy, and team process surveys, participated in a final AAR in which the competencies of mutual trust and backup behavior were discussed, completed the AAR Climate survey, and completed the open-ended questions that focused on trust, teamwork, the AAR, team roles, and game mechanics. Lastly, everyone participated in an open, facilitated discussion and feedback session. The workshop was four hours, with the gameplay lasting approximately two hours.

RESULTS

Demographics

Thirty-five people participated in the I/ITSEC workshop, with just one reporting they participated in Year 1 and 42% (n = 14) personally knowing between one and nine of the other participants. Participant age ranged from 21 to 60 years; 67% were male, 27% were female, and 67% were Caucasian. Most (70%, one to 30 years) reported having game development experience, experience playing board games and/or video games (90%, one to 45 years), working or playing on a team (97%, four to 45 years), having been in a supervisory role (79%, one to 20 years), and experience serving as an educator (88%, one to 32 years). About 30% reported they had active-duty military experience (three to 23 years), experience serving as an incident commander (18%, one to two years), and a few served as a first responder (6%, two to 4 years). Most liked cooperative (91%) and/or competitive (88%) games, and about 75% liked playing zombie video- and/or board games.

Sixteen people from within the HRC Directorate participated in the DEOMI workshop, and none had participated in the Year 1 workshop. Most participants (86%) knew between one and five of the other participants, age ranged from 24 to 65 years; 63% were male and 37% were female, and 65% were Black/African American, Asian, Hispanic or other race. Most HRC DEOMI participants reported having no game development experience (88%), some experience playing video- and/or board games (88%, two to 60 years), some experience in a supervisory role (73%, three to 45 years), and experience serving as an educator (81%, three to 41 years). About half reported they had active-duty military experience (three to 25 years), and a few had experience serving as a first responder (19%, two to 20 years). A majority liked cooperative games (93%) and competitive games (69%), and about half liked zombie video- and/or board games. Demographics were unrelated to survey responses.

Surveys

Table 2 shows Year 2 and HRC DEOMI workshop survey score means, standard deviations, sample sizes, and the Wilcoxon's signed rank t-test for pre- and post- game confidence, team cohesion, team efficacy, and team process, and post-game AAR for each group. The Wilcoxon test is a non-parametric statistic that is best used when the sample population does not meet the normal distribution requirements for parametric tests.

Table 2. Year 2 and HRC DEOMI workshop survey score means, standard deviations (SD), sample sizes, and Wilcoxon's signed rank t-test for pre- and post-game confidence, team cohesion, team efficacy, and team process, and post-game AAR.

	Game Confidence		Team Cohesion		Team Efficacy		Team Process		AAR Climate
	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Post
Year 2	2.55	3.00*	3.82	4.33*	3.76	4.14*	3.66	3.87*	5.83
	(0.72)	(0.80)	(0.72)	(0.52)	(0.77)	(0.51)	(0.76)	(0.55)	(0.88)
n=	31	29	33	30	33	29	32	29	25
HRC	2.5	2.87	4.09	4.45*	3.92	4.26*	3.76	3.99	6.14
DEOMI	(0.94)	(1.06)	(0.43)	(0.47)	(0.58)	(0.46)	(0.67)	(0.61)	(0.62)
n=	14	15	16	14	16	14	16	12	12

*p<.05

Overall, the Year 2 and HRC DEOMI pre- and post-game average scores were very similar. Lack of significant changes in HRC DEOMI scores may be due to very small, unequal sample size. Year 2 participant game confidence significantly increased, in contrast with Year 1 which was unchanged (M=2.8). Average HRC DEOMI participant pre-game and post-game confidence was about the same as Year 2. Although it was statistically unchanged, it did trend higher. Pre- and post-game ratings of team cohesion, team efficacy and team process were generally positive in both groups and similar to Year 1 ratings. However, unlike Year 1, pre- and post-ratings for all three measures significantly increased in Year 2, while only team cohesion and team efficacy significantly increased in the HRC DEOMI group, with team process trending higher but statistically unchanged. These findings may be due to the changes in the game. The Year 1 game was physically dynamic, with many participants enticed to leave their initial teams and join others starting in the second event as zombies attacked and team members had to adjust to almost everyone becoming a zombie by game end. In contrast, the Year 2 game made it beneficial for most participants to remain in intact teams until game end, with few becoming zombies. It is possible this slight difference resulted in the development of increased cohesion and efficacy. As in Year 1, AAR climate was regarded positively by both HRC DEOMI and Year 2 groups. Pre- and post-game survey responses by team location were similar to the means reported in Table 2.

Table 3 shows for Year 2 and HRC DEOMI, Spearman's rho correlations among pre-game and post-game measures of confidence, team cohesion, team efficacy, team processes, and post-game AAR. The Spearman's rho is a non-parametric statistic that is best used when the sample population does not meet the normal distribution requirements for parametric tests. Despite small sample sizes, especially in the HRC DEOMI group, there were strong correlations among many of the measures that were similar in size reported in Year 1 (Townsend et al., 2024) and in previous research reported by Johnston et al. (2019). In both groups pre-game confidence had a significant, but moderate relationship with post-game confidence, and as was found Year 1, was not related to the other measures. In the Year 2 group, except for post-game confidence, pre-game team cohesion was moderately to strongly related to pre-game and post-game measures and pre-game team process had weak to moderate relationships with them. Except for pre-game confidence, pre-game team efficacy was moderately to strongly related to the other pre-game measures and with all post-game measures. Low to moderate relationships were found among most post-game measures. Post-game confidence was not significantly related to team process or AAR climate. The HRC DEOMI group had a similar pattern of significant relationships among the variables. Pre-game team cohesion was moderately related to pre-game team efficacy and team process and post-game team cohesion and team efficacy. Pre-game team efficacy was strongly related to pre-game team process, but moderately related to post-game team efficacy. Pre-game team processes had a

moderately small relationship with post-game team efficacy. Moderate to strong relationships can be seen between post-game measures of team cohesion with team efficacy, team process and AAR climate. Post-game team efficacy and team process had moderately strong relationships with AAR Climate.

Table 3. Year 2 and HRC DEOMI Spearman's rho correlations among pre-game and post-game measures of confidence, team cohesion, team efficacy, team processes, and post-game AAR.

YEAR 2	PreG C	PreG TC	PreG TE	PreG TP	PG C	PG TC	PG TE	PG TP	PG CL
PreG C	-								
PreG TC	0.10	**0.88**							
PreG TE	-0.02	0.81*	**0.94**						
PreG TP	-0.04	0.62*	0.72*	**0.96**					
PG C	0.50*	0.27	0.34*	0.20	-				
PG TC	0.25	0.49*	0.42*	0.33*	0.62*	**0.92**			
PG TE	0.22	0.55*	0.67*	0.48*	0.50*	0.66*	**0.87**		
PG TP	0.20	0.49*	0.56*	0.51*	0.29	0.49*	0.69*	**0.91**	
PG CL	0.29	0.55*	0.47*	0.44*	0.28	0.49*	0.42*	0.42*	**0.88**
HRC DEOMI									
PreG C	-								
PreG TC	0.06	**0.90**							
PreG TE	0.03	0.68*	**0.91**						
PreG TP	0.14	0.50*	0.84*	**0.95**					
PG C	0.51*	-0.11	0.19	0.30	-				
PG TC	0.15	0.57*	0.40	0.44	0.03	**0.96**			
PG TE	0.02	0.71*	0.66*	0.48*	0.14	0.56*	**0.91**		
PG TP	-0.17	0.10	0.14	0.51	0.05	0.69*	0.31	**0.92**	
PG CL	0.05	0.20	0.15	0.32	0.25	0.83*	0.67*	0.71*	**0.66**

Diagonal - Cronbach's Alpha; *p < .05; Sample sizes in the I/ITSEC group ranged from 24 to 33, and from 9 to 16 in the HRC DEOMI group. PreG C = Pre-game Confidence; PreG TC = Pre-game Team Cohesion; PreG TE = Pre-Game Team Efficacy; PreG TP = Pre-game Team Process; PG C = Post-Game Confidence; PG TC = Post-Game Team Cohesion; PG TE = Post-Game Team Efficacy; PG TP = Post-Game Team Process; PG CL = Post-Game AAR Climate.

Teamwork

Across all locations, raters observed multiple instances of seven out of ten mutual trust behaviors, eight of nine backup behaviors, eight of nine initiative/leadership behaviors, and six of nine information exchange behaviors. Table 4 lists behavioral markers that received an "at or above" expected performance rating. Observers noted that at game start teams at each location immediately strove to work well together and remain together throughout the game (except for those becoming zombies). Examples of teamwork behavioral markers were found in the TDMS transcripts:

Mutual Trust – Team members protected the interests of their fellow team members by discussing they should make sure the Power Plant team took on more risk during negotiations to get a better deal:

- Person 1 – *Real quick, power plant came back with an offer. They're saying three fuel and two food for a doctor*. Person 2 - *Who is it?*

- Person 1 - *The power plant.*
- Person 2 - *Is that worth it?*
- Person 1 - *If they do the traveling*.
- Person 2 - *Yeah, if they do the traveling back and forth, I agree. Because they're accepting a lot more risk than that*.
- Person 1 - *Because they can lose without traveling back and forth*.
- Person 2 - *Or if they can bring us a vehicle*.

Backup – A team member balanced the workload by saying to another team member: *If you have extra stuff, you can always hand it to me*.

Initiative/Leadership –

- A team member stated priorities as the situation changed by saying - *Make sure all our resources are just together so that there's no confusion going on*.
- A team member was ensuring material resources were managed by saying - *We rolled one die to determine the level of damage to things, so we need somebody to roll and use six for the other side*.

Information Exchange – Team members shared information with each other about another table by saying:

- Person 1 - *Yeah so they didn't want, they were interested in a doctor*.
- Person 2 – *We'll take them over when they're dead. They were under zombie attack when I got there, and they lost.*
- Person 1 – *Oh, hey, we were under zombie attack too.*

Table 4. Behavioral markers that received an "at or above" expected performance rating.

Mutual Trust	Back-up Behavior	Initiative/Leadership	Information Exchange
• Appeared to feel safe enough with each other to take risks • Asked questions of each other to resolve issues • Had a shared understanding of priorities • Team members pulled together during a stressful time • Had a shared belief that everyone will perform their roles	• Team members helped each other out • Balanced the workload • Coordinated Actions with Others • Cooperated with each other	• There is an apparent leader on this team. • Provided clarity of purpose and direction • Stated priorities as situations changed • Personnel resources and material resources were managed • A team member took action to solve a problem	• Effective at sharing information • Exchanged diverse pieces of information to address an issue • Clearly articulated information • Communicated their drive to cooperate with each other • Communicated Effectively

Game Reactions

The number of Year 2 and HRC DEOMI participants responding to post-game reaction questions ranged from 25 to 28 and 10 to 14, respectively. Modifications to introduce increased socio-economic and organizational stability in the game dramatically changed game outcomes from Year 1, with only a few players leaving or switching teams, and a handful of Year 2 (three) and DEOMI (five) participants becoming a zombie horde master. Similar to Year 1, most Year 2 (89%) and all DEOMI participants reported they enjoyed the game either "somewhat" or "a lot," and similarly, would play the game again next year (Year 2: 96%, DEOMI: 93%). Participants in both the Year 2 and DEOMI workshops most often saw themselves as taking the roles of advancing new ideas, supporting, coordinating, and observing. Almost all Year 2 (97%) and DEOMI (93%) participants felt they could trust their own team mainly because they knew each other beforehand or shared a common goal. Whereas only a small number of Year 2 (8%) and DEOMI (17%) participants said they trusted the other teams because they deemed them suspicious or directly competitive. Nearly all Year 2 (96%) and HRC DEOMI (92%) participants agreed they would use or had been using teamwork behaviors and team self-correction AARs on the job (Year 2: 89%, DEOMI: 100%), citing the support of

long-term goals, the importance of teamwork, and pre-existing usage as the most common reasons. The most frequent recommendations for game improvement from both groups were for providing more time to learn and better clarification and simplification of game rules.

DISCUSSION AND RECOMMENDATIONS

As this was an exploratory study (i.e., participants were not randomly assigned to the game), we were cautious about conclusions drawn from the findings. To counter this weakness, demographics similarities in Years 1, 2, and HRC DEOMI groups indicate participants had the expertise needed to enable us to assess and observe important team attitudes and behaviors. Their expertise may also be the reason that we found teamwork was proficient throughout the game. We believe findings from Year 2, bolstered by findings in Year 1, demonstrate that engaging in low-fidelity tabletop games can be used to potentially improve important team attitudes that are strongly related to teamwork processes and performance. We also determined that teamwork behavioral markers are observable in game interactions and can be evaluated with multiple methods. Further analyses will be conducted on game performance using transcripts to examine, for example, performance related to behavioral markers of cohesion and efficacy, the extent of teamwork behaviors in communications, emergent leader activities, cooperation and competition between location teams, how information was transmitted from one location to another, and relationships with team attitudes. Future study should investigate this approach with less experienced participants, expand study to other important teamwork variables, and include relationships of these variables with objective measures of team performance game outcomes. Recommendations are:

- When properly designed with Stress Exposure Training features, low fidelity tabletop games can be used to increase levels of team cohesion, team efficacy, and team processes which are known to be strongly related to improved teamwork and performance.
- A training effectiveness measurement framework should include assessing critical team attitudes and behaviors, and measurement should be conducted before, during and after game play.
- Utilizing a tablet-based assessment can enable real-time identification and assessment of key teamwork behaviors that inform an effective AAR.
- Although time pressure is an important aspect of crisis management games, game familiarization training should enable players enough time to learn the game; for example, providing a quick video for context and conducting a simple use case tutorial prior to game.

ACKNOWLEDGEMENTS

We dedicate this paper in memory of Jerry Mize (USA Major, Ret.) who was tireless in his creative efforts to innovate game strategy, improve research, and instill a cheerful outlook in everyone. We are grateful to Jerry's wife and daughters (Catrina, Asiana, and Kay) and Dr. Hank Phillips for their energy and creativity in supporting workshop development and implementation that significantly elevated the quality and importance of the event, how it was perceived, and drew strong interest from leadership and participants.

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