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# OPTIMIZING REUNIFICATION CAPABILITIES AT OUTDOOR MUSIC FESTIVALS: EMPOWERING SOCIAL GROUPS TO MAINTAIN SITUATIONAL AWARENESS THROUGH GEOFENCING AND GEOLOCATION

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## ABSTRACT

OPTIMIZING REUNIFICATION CAPABILITIES AT OUTDOOR MUSIC FESTIVALS: EMPOWERING SOCIAL GROUPS TO MAINTAIN SITUATIONAL AWARENESS THROUGH GEOFENCING AND GEOLOCATION

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The purpose of this research was to apply Social Identity Theory concepts to a modified Technology Acceptance Model for existing application-based software technologies on android and iOS platforms in an effort to facilitate user expectations of reunification efforts for pre-planned or spontaneous evacuations of Outdoor Music Festivals (OMF). Geofencing technology combined with geolocation sharing software will enable users that "opt-in" the ability to interface, plan, and disseminate instructions when separated from their social groups. While the overarching goal will allow evacuees to maintain baseline situational/spatial awareness, the modified concept, when applied, functions as a pseudo-visual crowd analysis tool for evacuees to locate one another and report their safety status absent a formal or hasty reunification action plan. Enabling the crowd's ability to increase decision-making skills and self-reporting adds additional layers of accountability and control for festival promoters, state, and local coordinating authorities. Using Firefly Music Festival, located in Dover, Delaware, the research examined a multiday OMF with an on-site camping component and a daily maximum capacity of 50,000 attendees to garner input for respondent data. Research findings demonstrated that the perceived usefulness of an app led to a positive attitude towards using the application and adoption, and thus developing positive intention for actual use of the Firefly Music Festival Mobile App during the festival, by festival attendees.

## DEDICATION

To my mother, Karen, thank you for setting the standard so high and always believing that I was capable of more. My two sons, Jackson and Roman, you are my motivation in all that I do. Nothing has brought me more joy in this world than being your father. I encourage you both to follow your own paths with grit, determination, and uncompromising loyalty. Collect knowledge, study the arts, and lose yourself in the sciences of this world. My friend and brother in arms SGT Steven M. Packer (KIA May 17, 2007). I sincerely hope I have made you proud. The 10th Mountain Division soldiers, specifically the 2nd Battalion of the 14th Infantry Regiment, Alpha Company, "Terminators." May you always hold the honor and distinction of "*The Right of the Line."*

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# CHAPTER 1: INTRODUCTION

Current research regarding evacuation protocols of Outdoor Music Festivals (OMF) has seemingly compartmentalized evacuation procedures, crowd behaviors, and crowd safety, as though the urgency for evacuation ends at the gates to the festival itself. This siloed perspective is evident in both academia and the practitioner community. This study sought to understand what happens during an evacuation and how human behavior would impact reunification. A presupposed nondescript transfer of responsibility must occur for evacuees' continued safety and security from the festival to the state or local coordinating authority to assist in reunification efforts of lost, missing, or otherwise displaced persons. Yet the often-overlooked query persists of whether festival attendees can be empowered to such a degree to maintain situational/spatial awareness in order to reunify in a manner that accounts for the social instinctual response. One cannot assume that preplanned reunification sites will always be accessible to evacuees, as they may be forced either by design or through unforeseen circumstances to undertake reunification in small groups on their own initiative. Failure to subscribe to the totality of evacuation incidents, circumstances, and poorly defined planning assumptions surrounding reunification introduces what Bracken, Bremmer, & Gordon, (2008) described as countervailing risks once evacuees leave the confines of the festival and are forced to ascertain their next course of action (in either rural or urban environments).

The application of Lewin's equation concerning Human Behavior $B=f(P, E)$ is strongly considered across the OMF demographic and reemphasized as an important factor concerning reunification in total (Lewin, 1936). To understand [P] in the context of OMF reunification, we remove what Turner (1987) depicted as individual nomenclature

or self-categorization associated with crowds, and, by extension, Lewin's equation and replace it with social groups under the umbrella of Social Identity Theory (Tajfel, 1978; Tajfel & Turner, 1979). This mixed methods study will use qualitative surveys that rely on snowball sampling methods in order to validate and rank the importance of the social groups' cohesion versus the individual or the collective (macro) group throughout the multiday event (Smith, 1999; Reicher & Drury, 2011; Templeton, Drury, & Philippides 2015). The survey will also seek to validate "helping behaviors" or assimilations of individuals into existing groups that may manifest during evacuation incidents evidenced in the 2005 London bus bombing incident (Drury, & Alfadhli 2019), the After-Action Review (AAR) of the Route 91 Harvest Festival, (FEMA, 2018), and discussed by Drury et al. (2009a; 2009b); Von Silvers, (2014). Once established, additional survey questions will ascertain the likelihood of attendees forgoing privacy concerns while aligned to the Technology Acceptance Model (TAM) on Android and iOS platforms for safety, thus influencing the [E] environment in Lewin's equation by introducing geofencing and geolocation software in order to monitor and track evacuees' locations in near real-time. The hypothetical addition of a text function is a modification of the "Mobile Crisis App" proffered by Kaufhold (2021), while the ability to transmit issues with perceived safety/security to an actionable receiver are derived (in-part), from the "iSee" mobile application proffered by Ouyang et al. (2013). The survey will demonstrate a threshold for acceptance by allowing evacuees to report their current safety status or identify locations where reunification may occur, ultimately aiding evacuees by maintaining social coherence and psychological unity of group dynamics despite separation (Reicher

& Drury, 2011). The data generated through qualitative surveys will then be coded to determine the quantitative analysis of the findings.

This theoretical design was based in part on the emergence of agent-based modeling techniques advocating for the inclusion of social groups in modeling simulations (Aguirre, El-Tawail, Best, et al. 2011). This research will demonstrate the need for focused attention toward reunification efforts and, by extension, a fluid recovery process specific to social groups and their self-identified priorities during spontaneous evacuations that will apply to any future real-world incidents akin to the 2017 Route 91 Harvest Festival in Las Vegas, Nevada, and the 2021 Astroworld Music Festival in Houston, Texas.

## Research Questions

The purpose of this dissertation is to validate the extent of the social groups' level of confidence regarding evacuation notifications prior to social group reunification while in attendance at a multiday OMF. By applying a modified TAM, the research will establish a threshold of perceived usefulness (PU) directly related to the attitude towards use (ATU) of hypothetical crowd-connected software for situational/spatial awareness and reunification efforts for social groups that interface through Android and iOS platforms. Any modifications to an already established (trusted) mobile application such as the Firefly Music Festival application, can negatively impact the perceived ease of use (PEOU), which may adversely influence actual use (AU). Finally, the research will explore if the existing mobile application for the Firefly Music Festival can be modified for AU to serve both festival attendees and the command team's situational/spatial awareness relative to crowd movement, density, and location.

$R_1$. What is the overall level of Perceived Usefulness, Situational Spatial Awareness, Social Influence, Attitude towards Use, Actual Use, and Perceived Ease of Use for existing application-based software technologies on Android and iOS platforms to facilitate user expectations of reunification efforts for pre-planned or spontaneous evacuations of Outdoor Music Festivals (OMF)?

$R_2$. What is the relationship between perceived usefulness (PU) and the attitude toward use (ATU) of hypothetical crowd-connected software for situational/spatial awareness and reunification efforts for social groups that interface through Android and iOS platforms?

$H_0$. There is no significant relationship between perceived usefulness (PU) and the attitude toward use (ATU) of hypothetical crowd-connected software for situational/spatial awareness and reunification efforts for social groups that interface through Android and iOS platforms.

$H_1$. A significant relationship exists between perceived usefulness (PU) and the attitude toward use (ATU) of hypothetical crowd-connected software for situational/spatial awareness and reunification efforts for social groups that interface through Android and iOS platforms.

$R_3$: To what extent can the current Firefly mobile app technology be modified to serve the function of situational awareness using geofencing and geolocation for OMF attendees?

$H_2$: The technology can be modified for AU, but users see no increase in PU.

$H_3$: The technology cannot be modified for AU.

## Measurement

Firefly Music Festival in Dover, Delaware, is a multiday OMF on 105 acres, with multiple stages and on-site camping components. Firefly Music Festival met the criteria for inclusion as an established OMF where annual attendance may range from 50,000 to 90,000 attendees, and has operated for ten years, with an outlier of CY2020 due to the global COVID-19 pandemic.

In order to succinctly answer the research questions, qualitative surveys will rely on non-probability snowball sampling methods in order to validate the importance of the social groups' cohesion and rank it amongst other competing factors. This methodology best represents the shared social identity of festival attendees and social groups. While Firefly Music Festival does not have age restrictions for attendees, the ages for inclusion within this study ranged from 18-65+ to represent the sample population. The surveys were designed and validated to offer exclusion criteria for respondents who had not previously attended the Firefly Music Festival.

Surveys will also explore situational/spatial awareness concerns while applying the modified TAM on Android and iOS platforms by introducing geofencing and geolocation software to monitor and track individuals that comprise social groups' locations in near real-time, individual and group safety concerns/reporting mechanisms while in or around the festival and adding supplemental maps for various campsites.

## CHAPTER 2: LITERATURE REVIEW

### Crowd Perceptions & Behaviors

Earlier studies concerning the explanation of crowds, and by extension their behaviors, were rooted in Le Bon's work "The Crowd." To understand current prejudices with respect to crowds and their behaviors, one must carefully examine how these prejudices evolved into the current lexicon. Le Bon sought to establish the crowd as being mindless, irrational, frenzied, and susceptible to coercion and manipulation (Le Bon, 1895). Other attempts to explain what had been viewed as spontaneous congregations of directionless masses prone to infectious panic and stampedes would later branch into "herd behaviors" (McDougall, 1921; Trotter, 1921). Herd behavior (not to be confused with collective behavior) denotes the loss of individual behavior and the adoption of crowd influencers. While Ward (1924) admonished McDougall's interpretation of crowds and the overall application of herd mentality, he elaborated that such actions would go against society. Progressive writing would later turn the phrase "social facilitation" to illustrate leaders within social groups (Allport, 1924; Zajonc & Sales, 1966; Johnson & Feinberg, 1977). More than a century later, the literature first used to describe crowds and their behaviors continues to be used sparingly (e.g., Fahy, Proulx, & Aiman, 2011; Goltz, 1984), though the inclusion of such conversation fails to contribute constructively to scientific literature (Haghani, et al. 2019; Shipman, & Majumdar, 2018; Quarentelli, 2001). The current scholarly research of classical crowd psychologies as found in Stott & Drury, (2017), combined with various modeling techniques of crowd behaviors have since invalidated earlier presuppositions of mindless spectators posed by Le Bon, thereby reclaiming the crowd's rationality and condemning the 'pathologization' of social groups that form crowds (Aradau, 2015. p.157;

MacCarthy, et al. 2022; Reicher, 2011). Research has consistently demonstrated that even in emergency situations social bonds can endure under stress, aiding academia and practitioners alike to understand how crowds exhibit the potential to demonstrate reasonable signs of cooperation or helping behaviors or compassion (Aguirre, 2005; Cocking; 2013; Cocking, et al. 2009; Drury, 2003; 2011; Fahy, et al. 2011; Johnson, 1987; Mawson, 2005; Quarantelli, 2008).

Psychology and social sociology have laid the foundations for our modern understanding of crowds. Crowds and their behaviors have been scientifically proven to exist as an amalgamation of familial roles, relationships, fellowships, social roles in society, and social networks (Drury, 2011). Large-scale events such as OMFs have the potential to remove the individualistic nomenclature from attendees due to the event type and replace it with a shared social identity across multiple groups (Templeton, 2021), or what MacCarthy et al. referred to as the appeal of tribalism; 'to belong to something' (2022). Falassi (1987, p.2), went so far as to define the festival experience as "a sacred or profane time of celebration, marked by special observances." With this understanding in mind, it is fitting to return to Lewin's Equation of Human Behavior.

## Lewin's Equation of Human Behavior

While Lewin's equation has been regarded by many as overly simplistic, often there is a lack of practical application which creates a disconnect between academia and practitioner (Burnes, 2020; Colucci, 2018). Lewin's equation of Human Behavior, B=*f* (P, E), is appropriate when transferring the idea of human behavior to social groups (rather than the individual), as identity, group affiliation, peer influence, and social relations are well-documented matters of social identity (Best, 2013; Cornwell, 2003;

Drury, 2018; Feinberg & Johnson, 2001; Templeton, 2021). According to Lewin (1936), either P or E may be the dominate factor within the equation proffered as each factor is situationally dependent. Kihlstrom (2013) affirmed the comma within the formula denotes a flexible relationship between P and E.

P – Social Groups: If the social group can be agreed upon to exist as a complex, multifaceted social construct, then individualistic determinants are not individual at all, rather they are derived from a commonly shared social identity that binds social circles (Guyon et al., 2018; Hughes, Ellis, & Smith, 2023; Plonder, 2021). This abductive inquiry lends credit to the belief that behavior is influenced by the same social group and can be verified through social attachment modeling when evidence presented demonstrates a propensity for social groups evacuating together (Neville & Reicher, 2011; Shipman & Majumdar, 2018). All members of a social group may in fact share platitudes, which in turn are accepted or rejected within said group through inward or outward expression or behavior (Hughes, Ellis, & Smith, 2023; MacCarthy et al., 2022). At present, no studies were found illustrating the importance of social groups that are/become separated and how individuals within a social group might attempt to reunify post-evacuation.

E – Environment: Current research found that Information and Communication Technology (ICT) can influence behavior in the physical world, specifically in the context of festivals (Garay & Morales Pérez, 2017; Robertson et al. 2015; Van Winkle & Bueddefeld, 2020). Since this research encompasses both the physical and virtual domains, which are conduits for social groups' interconnectedness, it bears mentioning

moving forward throughout this dissertation that both physical and virtual environments act as (social) influencers of group behavior and the groups' actions.

Empirical research conducted by Van Winkle et al. (2013) affirmed the existence of strong relationships using the Brief Sense of Community Scale; which found that Information and Communication Technology facilitated in the social bonds/relationships of festival attendees. MacKay et al. (2016, 2019) conducted survey research of 345 festival participants at three separate festivals regarding how ICT (specifically active and passive social media usage) facilitated user engagement across three engagement dimensions: (affective, cognitive, and normative). The research illustrated an interconnectedness between active and passive usage related to cognitive and affective engagement, which the researchers found extended to pre- and post-festival.

OMFs such as Bonnaroo, Coachella, and Firefly have all integrated the festival experience in one way or another with a hybrid virtual interface to augment the users' time while in attendance. Ballantyne et al. (2014) validated that a physical or virtual connection bolsters a "sense of agency," which harmoniously heightens the sense of shared identity and mutual purpose (i.e., social and psychological well-being) amongst OMF attendees. The physical or virtual environment can even play a role in why attendees choose to return to the music festival (i.e., socialization spaces and degrees of participation) (Borges et al., 2021; McKay, 2015). While the OMF undoubtedly represents the environment in Lewin's equation, multiple case studies found that the length of the festival intensifies these feelings, thus validating the need for closer examination of multiday OMFs, which inadvertently would have a camping component. (Ballantyne et al. 2014; Croom, 2015; Packer & Ballantyne, 2011).

## Theoretical Framework

From a meso perspective, using the lens of social sciences, Social Network Theory (SNT) underpins the effectiveness or ineffectiveness of community cohesion and identity. While community could be considered an ambiguous term, SNT can be directly related to the durability of social capital through formal and informal social structures, interconnectedness, and community relationships regardless of formal or voluntary associations (Chamlee-Wright, & Storr, 2011; Ramsay, et al., 2020; Cudny, 2014). To that end, I ascribe to the notion that communication research, and by extension interactionist sociology, assists substructures of individuals within the community through formal ties called "nodes" (e.g., communities self-identifying within communities). As a result, it is imperative that the constructs surrounding recovery models and communication research be inclusive of both mass media and social media modalities so as to not adversely impact or limit generational groups (Felmlee, & Faris, 2013). The application of SNT may explain the meso perception of communities' interconnectedness, as social media has been proven to influence lifestyles, but could be interpreted as superficial when it comes to true social cohesion (Abdullah et. al 2022).

Duives et al., (2014) dissect the theoretical underpinnings of Dutch Music Festival attendees' attendance to such festivals and contribute to the theoretical knowledge of evacuation studies, specifically considering, and at times advocating for, "individual choice." Theory, research, and modeling based on social identity have been found to be comparable to personal identity (Erikson, 1968; Hargreaves et al. , 2002; Leaper, 2011). Individual choice was later broken down by Abreu-Novais & Arcordia (2013) in their empirical review of 29 separate studies which focused on motivating

factors for attendance at said festivals. Their study concluded that these factors could be broken down into seven categories: “socialization, family togetherness, event novelty, escape & relaxation, excitement & enjoyment, cultural exploration, and other specific motivators (e.g. food or event theme)” (Abreu-Novais, & Arcordia, 2013).

From personal identity to individual choice, one can easily arrive at Social Identity Theory (SIT), first proposed by Tajfel, & Turner, (1979). SIT is a representation of human behavior(s) that can be knowingly adapted by the individual to conform to the social situation (Tajfel, 1981; Turner et al., 1987). SIT is defined as “the characteristics of perceived membership in a relevant social group” (Tajfel & Turner, 1985). SIT is uniquely compatible, albeit new, within the OMF framework given that it examines one’s inward and outward perceptions as a group member through participation, group dynamics and relationships, and social cohesion and group synergy (Chiang et al. 2017; Getz, 2000). Returning for a moment to the findings of Abreu-Novais & Arcordia, regardless of how individuals classify their own participation in the OMF visa-vi, self-perception, group participation, intergroup relations, or social affiliations, the acceptance of group members is what Neville & Reicher (2018) would refer to as an endorsement of social identity.

Recent adjustments to SIT have lent credit to the idea of shared social identity (Neville et al., 2022). This research recognizes shared social identity, given that the nature of social identity itself is founded upon the notion of being a shared experience. Shared social identity, according to Lickel et al. (2000) and Neville et al. (2022), refers to a specific subset of persons that view their membership as part of the common identity, thus, creating what Cocking (2013) referred to as a cohesive group identity which would

be wholly applicable for group members that invest both time and financial resources to see their favorite bands perform live within the OMF context.

The experiential value experienced through SIT specific to OMF can simply be the shared experience (intangible) but may also include physical benefits (tangible) (Eroglu et al., 2005; Oh et al., 2007; Wood & Masterman, 2008). Torres, et al. (2018) provided research to support experiential value and shared social identity in groups that attend OMFs. The authors investigated 1553 respondents from 40 countries to discern participation and interest levels in seven different group events. The research sought to understand why respondents would attend and their willingness to go alone versus in groups. The research demonstrated a global consensus that "(a) the majority of the participants often go to collective events, but different events have different levels of participation; (b) people rarely go alone to collective events, but the company depends on the type of event; (c) although the results show it is not necessary to like the event to trigger participation, people have different reasons for going to different events" (Torres, 2018).

Social Identity Modeling (SIM) [of crowds] demonstrates a propensity for the removal of individualistic classifications and instead favors group dynamics and associations (Neville & Reicher, 2018). Meanwhile, Social Identity Mapping (SIM) [of individuals within social groups] has also emerged to illustrate the frequency and dynamics of social identity networks which have assisted in explaining inter-group relations (Bentley et al., 2020; Cruwys, et al., 2016; Hughes et al., 2023).

## Evacuating Soft Targets/Crowded Places

Soft Targets/Crowded Places (ST-CP) are sites or locations inherently open to the public with limited protective measures or security in place due to their operational characteristics. Soft targets can include performance venues such as OMFs and have even been the setting for real-world incidents that required evacuation (Okřinová et al., 2020; Seebock, 2018) [see Route 91 Harvest Festival; Astroworld Music Festival]. Due to the open design of OMFs, weather can also factor into limited-notice or "planned" evacuations [see Indiana State Fair stage collapse 2011; Medusa Festival 2022]. Firefly Music Festival itself has experienced two full-scale weather-related evacuations in 2015 and 2022.

At present, few studies incorporate the on-site camping component of festival attendees and how traditional evacuation strategies might compound issues for this demographic. Sheltering in place during a weather-related event may be a reasonable request. However, the same might not be true for an active assailant threat as evidenced by the 2023 Beyond Wonderland OMF, at the Oregon Gorge amphitheater (campground). While camping is not universally available for all OMFs, this is a delimiting factor found in the current body of published works. This can be a concerning trend for multiday events given that attendees will spend a considerable percentage of their time outside the confines of the actual festival yet reliant on the festival structure for guidance and information. In compiling current research, evidence suggests that past and present recommendations are drafted from siloed perspectives, thus lacking a multidisciplinary problem-solving approach.

There are, and have been, legal liability considerations specific to event planning regarding OMFs when circumstances preemptively create scenarios that cause evacuations where attendees are injured or killed (Guthrie, 2020; Mules, 2004). Inadequate planning of festival/venue layouts such as the 2010 Love Parade music festival in Duisburg, Germany is in fact a twofold problem that begins with festival promoters and later became compounded by festival attendees creating cascading risks (Bracken et al. , 2008; Helbing & Mukerji, 2012). Evacuation through private areas of the festival (that are generally off-limits to festival attendees), such as artist area(s), staff areas, private food service, security, or fire/EMS routes; commonly referred to as the Back of the House (BoH) of OMFs poses equal if not greater risks given the unfamiliarity of where evacuees are in relation to where they may find safety. When the first exit choice is not immediately available, research has validated that attendees will rely (in part) on signage to direct them to a safer area (Chu et al., 2014; de Vries et al. , 2014; Gärling et al., 1986). Light emitting diodes (LED) displays that turn on and off to relay messaging have already proven useful to relay information in real-world festival settings. The on-off functionality is reinforced by de Vries, et al., (2014) to retain the attention value of the intended audience. Turner and Penn (2002) further validated that when appropriate signage is visible and understandable that the need for additional support staff need not be present to facilitate a proper evacuation. This is promising when considering the work of Earl et al. (2005), which confirmed inadequate/unqualified staffing may exacerbate evacuation-related issues. Improper signage may also delay evacuations for individuals as attendees may be hampered or impaired visually (Best, 2013; Haghani & Sarvi, 2016), physically impaired with limited or no mobility (Chapman, Carmichael, &

Goode, 1982), or incoherent while under the influence of illicit drugs or alcohol (Jaensch et al. 2018; Norman et al. 2021).

Future work related to multiday music festival alcoholic consumption by patrons should evaluate the feasibility of replication studies like transdermal and breath assessments, which coincide with self-reporting in order to properly assess the frequency with which patrons might become incapacitated (Norman, et al. 2021). Illicit drug use is of particular concern for multiday OMFs due to the extended hours of live music and excessive strain from consecutive days spent at the festival itself (Palamar, & Sönmez, 2022). Trainor, Murray-Tuite, Edara et al (2013) failed to acknowledge impairment for evacuees, though the authors were cognizant to discuss (in small measures) evacuees' "choice" as a matter of destination preference. However, in evaluating choice, the authors overlooked crowd manipulation from the perspective of social media influencers, which may interface with crowds through virtual platforms (human-computer interaction), or what Johnson & Feinberg referred to as crowd influencers (leaders) and how that influence may alter or facilitate a change in crowd intentions (1977).

The fact that "choice" data is gathered pre- or post-incident insinuates a greater probability that cognitive behaviors play an active role in decision-making (Mao et al., 2019). That said, the perception of "choice" is a matter of perspective and may merely exist as the illusion of choice; thereby acting to the detriment of computational capabilities with respect to mode (Haghani & Sarvi, 2018). Choices, in the truest sense, must also be subjected to academic rigor in order to validate that social groups' exit selection are not made in a proverbial bubble (Best, 2013). Bode & Codling (2013) conducted virtual simulations of human exit choice and evacuation. The authors

determined that when evacuees were placed under stressful situations to make evacuation decisions, the evacuees demonstrated no personal preference for familiarity with routes but did demonstrate apparent irrational decision-making behaviors. While Chu et al (2014) did not mirror the Bode and Codling study, the authors stipulated that “social cues” (the location and line of sight to other group members) may explain otherwise irrational observations. These social cues can help clarify crowd flows towards alternative exit choices; prompting a decision matrix that might appear irrational but is otherwise rational given observational context and the perceived threat. Other experts have argued respective of panic-induced situations that “the existence of mutual emotional facilitation is not denied, non-adaptive group behavior is thought to be closely related to perception of the situation and expectation of what is likely to happen” (Mintz, 1951, pg.150).

It is an understatement that crowds may pose significant logistical problems, the least of which is confusion and congestion during ingress and egress. Aldo (2004) examined OMF and summer entertainment venues between 1992-2002 to garner the risk of serious injury or death, then extended the search to 1974-2003 to look at crowd deaths specifically. While the review encompassed crowd congestion and "pressure points" within crowd structures, the author’s scope is broad and, at times, reaching as if to justify a conclusion or outcome reverent to herd behaviors; dismissing “why” something happened altogether. Barr, Drury, & Choudhury (2022) emphatically argued that systematic research is still lacking to explain false alarm events [e.g., the Las Vegas’ Lovers & Friends Fest 2022] which precipitate crowd crush, crowd stampedes and new terminology [urgent crowd flights] in terms of “frequency, the risks they pose, how

people behave, and the conditions under which they occur." The authors' research examined these events from 2010-2019 and found that competitive behaviors are rare but confirmed an inextricable link to environmental and human-caused constraints.

Ma, et al. (2013) confirmed the validity of human-caused constraints by conducting simulations and exploratory research. Examination of the 2010 Love Parade music festival incorporated pedestrian movement and speed (gait), stress levels of attendees, and individual(s) intention to escape. Such indicators are reminiscent of findings regarding "crowd turbulence, crowd quakes, and crowd crush (Helbing & Mukerji, 2012; Ma et al., 2013). The findings provided by Ma et al. (2013) regarding the 2010 Love Parade music festival elucidated how human-caused events specific to crowd turbulence, crowd quakes, and crowd crush may occur. The authors stipulated that while there was no perception of intentional pushing/shoving, under such circumstances, where bodies are in motion against one another, the pedestrians still induced a force spread, which in turn led to what the authors described as "velocity fluctuation" (Ma et al. 2013). Crowd crush scenarios have emerged as a significant problem for OMFs as the density in and around stage fronts is known to be high (Ronchi et al. 2016). This was evident in light of the recent real-world tragedy surrounding the Houston Astroworld Music Festival in 2021.

Several different modeling techniques are proposed to be the most reliable method to determine the time necessary to complete an evacuation. A strategy focused on evacuation by a factor of time does not account for emotional distress or lead to increased levels of safety (Ronchi et al. 2016). In addition, what is often considered optimal from a route selection perspective by factors of time or distance is attained by assuming that the

agents within the modeling system have the wherewithal to know where to go based on an accurate familiarization/memorization of their surroundings; and that the surroundings have not changed (Chu et al. 2014). Firefly Music Festival has consistently changed the festival layout to accommodate crowd sizes ranging from 50,000 – 90,000 attendees. Therefore, the year-to-year changes could add confusion and distress for returning attendees who believe they are familiar with the previous year's layout.

These evacuation studies vary from cellular automata (Burstedde et al. 2001), multi-agent continuous evacuation modeling, which has the capacity to handle large-scale simulations (Ronchi et al. 2016), numerical models that used microscopic agent technologies for large-scale evacuations (Okřinová et al. , 2020), to agent-based models that incorporate intra-group interactions, inter-group dynamics and a decision tree matrix (Aguirre et al. 2011). Agent-based modeling has also been linked to Computer Vision Technology (CVT) to discern the relationships between human flows, and crowd crush conditions (Yogameena & Nagananthini 2017). Such endeavors have led to the reemergence of Langevin equation-based force models, and particle dynamics modeling (Moore et al.2008) using simulations based on empirical evidence to discern crowd flows, density, and catalysts for panic. While numerical models are superior to handling large crowd sizes, they do not account for social identity or the social sciences as a whole to explain why delays may occur during evacuations (Riad et al. 1999). Other researchers, such as Blanke et al. (2014), caution against agent-based simulations, relegating its functionality as an appropriate planning tool but imprecise when determining the complexity of actual crowd behaviors.

## The Emergence of Ride-sourcing/Ridesharing and Evacuation

Utilizing ride-sourcing/ridesharing as an evacuation method within the OMF context is especially pertinent, as it has been put into practice in the real-world during the Nevada Route 91 Harvest Festival incident. Ride-sourcing/ridesharing is still an emerging field for private sector partners and emergency management agencies to consider. While ride-sourcing/ridesharing may provide choices for individuals to disengage from perceived threats/hazards in certain situations safely, it also adds complexity in that ride-sourcing/ridesharing may not always be an available option, regardless of its inclusion in the planning process. The 2023 Burning Man OMF in Black Rock Desert, Nevada, experienced unexpected flooding, which lead to safety concerns, shelter-in-place orders issued, and road closures along ingress and egress routes that stranded 70,000 festival goers from evacuating themselves and their belongings through the use of ride-sourcing/ridesharing assistance.

A study conducted in 2018 added additional variables, such as ride-sourcing/ridesharing during no-notice evacuations, in addition to time variables using numerical simulations. The study paid particular attention to "the use of shared-mobility resources during emergency evacuations based on a stated preference survey" (Li et al., 2018). Borowski & Stathopoulos (2020) similarly looked at ride-sourcing/ridesharing alternatives from the United States for evacuations, though due to the nature of the study, they were forced either by design or happenstance to select states with an already robustly existent infrastructure for ride-sourcing/ridesharing. This study would not be feasible for replication at Firefly Music Festival given that the capabilities and capacity for ride-sourcing/ridesharing assistance would be limited, as the infrastructure for ride-

sourcing/ridesharing within the city limits of Dover, Delaware, has yet to be either reliable or consistent in mass quantity.

Based on the continued use of ride-sourcing/ridesharing as a travel modality, it is necessary to update current planning assumptions and processes for both academia and practitioners that allude to an alternative means of evacuation based on how people travel and the emergence of new social norms regarding the acceptance of ride-sourcing/ridesharing; specifically, to events where parking or excessive consumption of alcoholic beverages may be an issue. Current research in this area is growing. The work submitted by Li et al. (2018) is a transformative planning approach that looks at how evacuations may stall under a no-notice event. Practitioners are perhaps better suited for the strengths and weaknesses of ride-sourcing/ridesharing as an alternative means of evacuation given the real-world situation of the recent Route 91 Harvest Festival. The After-Action Report (AAR) annotated that attendees utilized ride-sourcing/ridesharing to evacuate while companies simultaneously suspended service fees (FEMA, 2018), yet there is no mention of prior planning between Uber, Lyft, the planning team, or festival promoters. Based on open-source information, and in-person interviews with the Southern Nevada Counter Terrorism Center, one can only infer that between nine law enforcement agencies, four fire departments, and three private ambulance companies providing services to the festival, ride-sourcing/ridesharing filled a real-time gap in services based on the needs of those in attendance. At the time of this dissertation, research regarding "where" to take evacuees and "what" policies might hamper that assistance by ride-sourcing/ridesharing agencies is unavailable/inaccessible. Academia has yet to assess the perceived risk to driver safety or sudden self-presenting at local area

hospitals (which may already be at capacity) during an active assailant or mass casualty event.

Naoum-Sawaya & Yu (2017) addressed the strengths surrounding ride-sourcing/ridesharing evacuation from a macro perspective, ideally including assistance with roadway congestion, fuel supply issues, and limited transportation access. Due to the still-emerging concept of sharing economy, Seddighi & Baharmand (2020) conducted a systematic review of 80 available peer-reviewed journal articles that met the authors' inclusion criteria. However, when further refining the search for inclusion regarding the sharing economy in the context of "emergencies" or "crisis," only eight peer-reviewed articles was left. Their findings are indicative of the aforementioned gap in the available literature in the context of how ride-sourcing/ridesharing might assist and how it relates to tactics, techniques, and procedures for the practitioner community as a whole. That said, of the reviewed articles, the authors detailed a decentralized approach where both direct and indirect coordination had the potential to achieve the same results during an evacuation, which mutually supported Naoum-Sawaya & Yu (2017) and the AAR of the Route 91 Harvest Festival.

The work of Fruin (1987) was utilized as a foundational assessment regarding hybrid pedestrian/vehicular evacuation to explain and understand nuances related to both variables. Yuan & Puchalsky (2015) built upon the aforementioned framework and examined how dense urban area evacuations interact with existing traffic models by applying a dynamic sequential assignment method, which is wholly appropriate for multiday music festival evacuations. Research that does not make its way into the hands of practitioners (such as state transportation offices) may only discover such solutions

after failure. Some OMFs have moved from rural “off the grid” locations to dense urban areas for logistical support, which may adversely impact an existing population. Both rural and urban venues will have strengths and weaknesses regarding the reliability and the capacity of the cellular network needed to secure transportation. Ngoc-Anh T. et al. (2011) detailed hybrid modeling, Macro Modeling (equation-based modeling), and the advantages of Micro Modeling (agent-based modeling) outside the U.S. This hybrid modeling in addition to intelligent agent-based modeling may aid future evacuation studies for OMF, especially if such studies incorporate crowds, existing road networks, traffic flows, and seasonal effects on traffic density.

**Crisis Communication, Public Information and warning, and Social Legitimacy**

A comprehensive analysis of crisis communication must first consider what constitutes a crisis and analyze delimiting factors for inclusion. By doing so, academia and practitioners gain answers to 'why' crisis communication is important and establish a threshold for 'when' to utilize crisis communication.

The question of “how” to relay crisis information was examined independently by de Vries et al. (2014), Simon et al.(2015), Tan et al. (2017), and Xu (2020). de Vries et al. (2014)conducted an exploratory study replete with expert interviews and analysis regarding the effectiveness of social media messaging and its influence on crowds. One important finding that does not appear elsewhere illustrated that while social media may inform, contributions from other users mixed with event organizers might have a deleterious effect on those seeking pertinent information that might assist them in an emergency, thereby losing the effectiveness of the platform effect and messaging itself. The authors emphasized the modality of communication within the sphere of technology

can complicate communication with crowds (2014). Simon et al.(2015), separately acknowledged the possibility of misinformation through their work and offered that social media usage had the ability to expeditiously correct mis-information, as it is self-regulated. Tan et al. (2017) utilized scoping reviews and found 49 articles that met with the author's inclusion criteria regarding crisis informatics and mobile apps during disasters, as well as the subsequent value these apps had on the incident. According to Tan et al. (2017) mobile technology through the app-based culture improves public preparedness and impacts the relationship between the public and authorities. Xu (2020) conducted a quantitative meta-analysis between perceived crisis responsibility and crisis communication persuasiveness using social media variables opposite traditional media notification systems. When comparing the two modalities, individuals perceived a negative effect on crisis responsibility with social media notifications. Meanwhile, the study found no significant differences between both variables regarding the persuasiveness of the messaging (Xu, 2020).

A counterpoint to Xu's assessment can be found in the works of both Sadari et al. (2021), or Simon, Goldberg, & Adini (2015). Both authors argued that social media may be the only infrastructure with reliable service after an incident/disaster occurs, and conventional methods are limited or overwhelmed. This further validated the work conducted by Tan et al. (2017). Many authors agree that the evolution of technology and technology acceptance towards the usage of social media and mobile apps that are "general-purpose" or "built-for-disaster purpose apps" as a medium with which to disseminate information to the public or other trusted partner agencies has been linked to

evolution of ‘crisis informatics’ (Hagar, 2015; Reuter et al., 2018; Reuter, & Kaufhold, 2018; Tan et al. 2017, p.297).

Coombs and Holladay (2012) proffered that there was no universal definition regarding crisis. This research ascribes to the following definition: “a specific, unexpected and non-routine organizationally-based event, or series of events, which creates high levels of uncertainty and threat or perceived threat to an organization’s high priority goals” (Seeger et al.,1998). The definition, as stated in its unaltered form, is holistic but fails in its universality. Several delimiting factors compound issues related to this definition. Crisis, crisis management, and crisis communication are linear and without clearly delineated boundaries for where one categorical variable begins and the other ends (Coombs & Holladay, 2012). Conversely, Coombs' later work offered another salient point in that crisis communication acts as a catalyst for crisis management, thereby making these variables conditional (Coombs, 2021).

Crisis communication is often inextricably linked with public information and warning, yet theoretical underpinnings in which these frameworks exist are dissimilar. Crisis communication and public information and warning are affiliated with crisis management, which continually arises as an entangled member of both fields. Grunig (1976) and Slabbert & Barker (2011) delve into crisis communication processes and communication theory. While Grunig saw crisis communication as reactive (in his time), both the work and research have evolved to look at this type of communication as being “proactive, reactive, and post-evaluative” (Slabbert & Barker, 2011). Meanwhile, an evolution of what Quarantelli & Dynes (1977) deemed simply as symbolic interactionist frameworks has migrated into contingency theory – the suggestion that there is no best

practice for decision-making, and appropriate recourse is dependent upon the situation – which exists at present as a grand theory of public relations (Sellnow & Seeger, 2021). The theory was found to be the dominant theory during a systematic review of related works from 1997-2020 (Lee et al., 2022).

Although both variables were observed to be used interchangeably, much to the chagrin of some scholars, it is noteworthy that contingency theory and public information and warning play a significant role in shaping social legitimacy concerning organizational values, stakeholder opinions, and public sentiment in contemporary society (Hearit, 1995). Social legitimacy details the response for public information and warning as technology allows for businesses (such as OMFs) to target conflicting issues that may hurt or disparage a brand before, during, or after an incident (González-Herrero, & Smith, 2008). Social legitimacy also assists in managing public expectations (Quarantelli & Dynes, 1977; Jong & Brataas, 2021), though it fails to advise or assist in categorical variables of information being either known, unknown (but believed to be true), unknown (but believed to be false), or inaccurate. A separate study content analysis of 1,847 postings related to the Love Parade music festival disaster in 2010 was reviewed. Of the two popular social media message boards examined, experts determined "that attributions of cause and responsibility are important predictors of public' evaluations of organizations in crisis situations" (Schwartz, 2012, pg. 431). These evaluations can ultimately lead to perceived violations of trust and jeopardize social legitimacy.

In the context of public information and warnings, practitioners cannot assume trust, which may have cascading effects on evacuation efforts (actions taken versus

actions intended) and the reunification of social groups. According to Hutson (2014), trust will affect the efficacy of leadership during a crisis. These actions are largely based on how well situational knowledge is communicated with those affected. To that end, communication (however it is transmitted), must also reach the intended target audience it seeks to serve. Public information officers must tread a fine line of understanding, using warnings and alerts to inform and frame issues related to incidents (Gist & Lubin, 1999; Sellnow & Seeger, 2021). However, warnings themselves are vulnerable to competing narratives, perceptions, and contraflows of information exchanges; which would be assumed to have deleterious effects on public trust and confidence (Preston, 1979). Virtual interfacing platforms (specifically), social media data, is confounded by barriers of trustworthiness, which was found to be a significant predictor of its usefulness in emergency situations (Plotnick & Hiltz, 2016). Contraflows are, in terms of "crowd speak," unavoidable. Regardless of intent, "warning" from a prima facie stance is intended to provoke a reaction or elucidate higher-order thinking. In the case of OMF evacuation/reunification, competing narratives can arise as festival attendees demand reliable and consistent information. This information should not be confused with a generalizable narrative approved for public consumption due to privacy concerns.

Busselle and Bilandzic (2008) stipulated that public persuasion, that is, the persuasion of individuals and groups, deals with what they deemed as mental models. These models are character models, story world models, and situation models (Busselle & Bilandzic, 2008). Each model targets different audiences and influences them in specific ways. Any divergence from the appropriate narrative or the appropriateness of said narratives will conflict with the mental models, thus adding or detracting from the

individual's decision-making abilities and cognitive speed with which they delay or act on information. More recently, communication experts have argued for ways around the barriers to persuasion, returning to psychological reactance theory which originally contended that individuals have a basic need to choose their individual opinions or actions (Brehm, 1966; Braddock, 2020). Mental models were unaccounted for in the earlier work of Xu (2020) and were absent from evacuation studies. However, mental models can be attributed to social influence and evaluated through various means. Large-scale group emergency decision-making (LSGEDM) has recently emerged as a potential conduit for the gap in available literature (Zhu et al. , 2023). The authors affirmed that accounting for social group psychological factors of the decision-makers, such as "hesitation risk" (Ding et al., 2021) and "trust risk" (Xu, 2020), are vital to understanding social influence and the reliability of LSGEDM. Given that the metadata was derived from online open-source information, academia might also apply the inclusion of LSGEDM to social legitimacy.

Crisis communication is susceptible to "conditions of stress, an increasing convergence of unfiltered information which reduces the organization's capacity to respond effectively" and communicate that perception to the intended audience (Quarantelli & Dynes, 1976). Crisis communication is a fluid process and while fallible, from a point of personnel or resource (equipment) scarcity, the single point of failure is generally what information is being relayed over the communication infrastructure itself (Quarantelli & Dynes, 1977; Moore, 2020). Such failures within the aforementioned infrastructure may lead to a destabilization of trust within social groups.

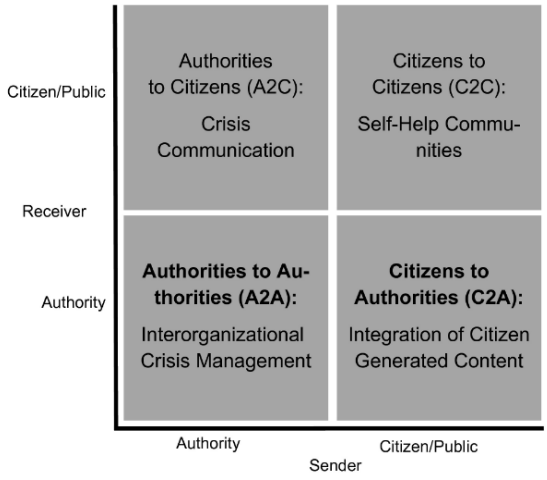
Bracken et al. (2008) explored warning systems as analytical tools adopting the warning value chain. Both crisis communication and public information and warning play pivotal roles in incident response as both rely on the flow of communication. Such actions are "intended to reduce threats to life safety, to care for victims, and to contain secondary hazards and community losses" (Tierney et al., 2001). While authorities may initiate public information and warning before disasters (i.e., *proactive*), the precipitous nature of such events implies that advance warning is possible.

Social media has emerged as a superhighway of interconnectedness due to its accessibility, outreach capabilities, and convenience in both sending and receiving information related to emergencies (Imran et al., 2015; Mitcham et al., , 2021; Reuter, Hughes, & Kaufhold, 2018; Reuter & Kaufhold, 2018; Van Winkle & Bueddefeld 2020; Weyrich et al. 2021; Wukich, 2015). In order to promote a homeostatic environment for both the collector and receiver of virtual information for systematical analysis, Reuter et al. (2012) derived a classification matrix for mutual aid and cooperation in crisis situations, depending on [sender] (x-axis) and [receiver] (y-axis) regarding digital information. While the matrix lacks a key component (public trust/confidence), ideally, consumers of information can accept was has been proffered as factual though, in some instances, not always practical. Reuter breaks down the data flows into four quadrants: on the inter-organizational level, organizations tasked with maintaining situational awareness and response communicate with one another (A2A). On the public level, citizens, witnesses, volunteer organizations, or those affected by the incident transmit information from sender and receiver through real or virtual platforms (via social media), these platforms could include, but are not limited to, Twitter, Facebook, Instagram,

Snapchat, or LinkedIn (C2C) This decentralized information sharing is also known as peer-to peer backchannel information (Houston et al., 2015; Xiao, Huang, & Wu, 2015). While the content is supplied by the observer/ public at-large, emergency management/response organizations screen the data. Note that the information does not automatically become social media intelligence (SOCINT) unless someone screens it (C2A). The final quadrant in the Reuters matrix insists that citizens and emergency management/services organizations (which may include private sector partners) communicate to inform the public (A2C).

**Figure 1**

Crisis Communication Matrix




Crisis Communication Matrix (Reuter et al., 2012), adapted for terminology

Conversely, social media can broadcast the appearance of strong divisions where information is believed, or people discount the information they are provided.

## Reunification in Social Groups

Returning to the earlier works of Bracken et al.,(2008) regarding how to manage strategic surprise, the authors cautioned the overreliance on standardized methodologies

and a comfort level with which practitioners found familiar as the environment evolved alongside the protection and response models employed. Fear can manifest from a variety of places. Van Rythoven endeavored to transpose fear in greater detail as it related to the politics of emotion and security. To expound further, Van Rythoven discussed how political intervention and remediation measures in the prevention, protection, and the response phases of security may intensify fears regarding the very vulnerability they seek to deconstruct (Van Rythoven, 2017). These fears may even explain the gap in the socialization of plans with the intended impact audience (beyond what law enforcement deems as sensitive information). The review of available literature illustrates not only a gap in reunification planning post-evacuation, but also a lack of empowerment articles that might illustrate how to initiate reunification when either a lack of planning or a lack of socialization of plans exist. Drabek (2018) urged the practitioner community to closely examine the actions they will take to protect the public. This may include socializing plans regarding reunification and recovery with the intended audience the plan seeks to serve.

In order to assuage concerns regarding how crowds may react to messaging, Drury et al. (2013) and Oh et al. (2010) contend that messaging or situational awareness (particularly from credible sources) allays anxiety, which in turn may assist in long-term psychological recovery in incidents where safety and security are present. Drury's assessment, in conjunction with quantitative data science and geo-referenced social media posting provided by Andreson et al. (2019), one can conclude that communication pre-incident has the ability to familiarize intergroups and intragroups with possible

answers to questions that will arise post-incident through scalable data that illuminates specific human behaviors, actions, or perceptions (Bica et al. , 2020).

The scarcity of available literature regarding reunification efforts without political entanglements, which includes enabling said efforts, is alarming. Most available literature referenced illegal immigration, wartime separation, and the reunification of foster family members. I submit that I have no bias for such articles and submissions. Academia (as a whole) and the Emergency Management Institute (EMI) underrepresent facilitated reunification processes and modeling across the homeland security enterprise from the perspective of man-made incidents or technological hazards. The author examined natural hazard contexts to understand the advances in reunification post-Hurricane Katrina, though most efforts produced personal development stories regarding the increased use of social media. Exploratory research was conducted concerning the 1993 World Trade Center Bombing, the 1995 Oklahoma City bombing of the Alfr ed P. Murrah Federal Building, and the second attack on the World Trade Center in New York City in 2001. Articles were screened for inclusion, though the research produced competing theories consisting of a hierarchical structure and comparison for displacing personnel which lacked comparability. Tourism and special events created the only avenue from which to draw literature.

The development of ‘music tourism’ has the potential to draw crowds from a variety of geographical locations due to the nature of the event, or if the event's significance appeals greatly to a subsect of certain populations (Gibson & Connell, 2005; Plangpramool, 2013; Van Winkle & Bueddefeld, 2020). Festival attendees are, therefore, bound by a precarious set of circumstances when forced to determine where to go during

an evacuation, how to stay together (if co-located), and how to reunify post-evacuation, given that evacuees may not have viable alternatives for secondary accommodations or be familiar with their surroundings. The importance of evacuation route selection should be expanded to include the psychosocial knowledge regarding collective behavior's found within social groups in conjunction with shelter/reunification sites (Aradau, 2015). From this knowledge, academia and practitioners alike must be prepared to generate effective (maximized) pedestrian traffic flows while minimizing contra flows and other crowd impediments (Amideo et al. 2019).

Furthermore, reunification extends beyond reunifying person (A) with person (B). Reunification, specifically within the context of the OMF camping demographic, must also consider the efficacy of the reunification processes regarding personal possessions with displaced evacuees. Practitioners within the sphere of emergency management must incorporate strategic planning for where the displaced will be housed (absent personal possessions), during a prolonged event, as the displaced festival attendees will be expected to sustain themselves alongside an existing population. There is an ostensible lack of available literature that elucidates an acceptable timeframe for reunification of person(s) with belongings. These expectations, if not met promptly, may cause consternation and greater concern in the context of a holistic reunification.

## Geolocations, & Geofencing

Fortescue and Birnie, developed a U.S. patent in 2008, which illustrated the practicality of using GPS methods to authorize members within a specific social network to request the positions (proximity), and time synchronization of others within the same social network. The terms social network and social identity are interchangeable [within the patent design], though they still describe the same function of an accepted communication from a trusted person(s). Location-based asynchronous thread communications are the conduit from theoretical to practical application when discussing how to send and receive messages within a geofenced area (Sayed, 2014). The impact of combining smartphone capabilities and human competency to contribute to complex problem-solving techniques illustrates the potential evolution to interface, plan, and disseminate instructions when an individual is separated from their social groups without intervention or assumed responsibility from an outside entity (Anderson et al. 2019; Chatzimilioudis, et al. 2012; Ouyang, et al. 2013). It is key to understanding the technology is already available when determining its usefulness within the prescribed setting. This dissertation capitalizes on the successes of innovation and technology, applying it to social groups in the OMF setting, the social groups understanding of how the technology applies to them, familiarization with said technology through similar apps, and subsequently facilitating the user experience and how attendees interact with the festival (Blanke et al. 2014; De Geus, et al. 2016).

Academia and practitioners should consider geolocation as both a commodity and part of the information market system, which often influences economic systems and platforms (Alvarez León, 2018). Alvarez León (2018), Anderson et al. (2019), and

Blanke et al. (2014) elaborated on aspects related to established locations (georeferencing, geotagging, and geolocation) and timestamps related to postings made by users, which allows for an ability to extract/interpret real-time movement data, while simultaneously generating targeted search fields for group members. The geofenced area can be utilized as a passive control which monitors exits and entrances (Blanke, et al. 2014). Such enhancements can also act as passive controls by festival promoters in conjunction with incident commanders as geofencing and geolocation coincide with current trends in empirical research regarding "crowd counting" and "visual crowd analysis" (Haghani, M. 2021).

Konomi & Sasao (2016) examined the establishment of 1,100 hasty geofences established by crowd workers in urban areas. Researchers prompted field teams to enter the geofence area and receive notifications, including safety alerts such avoiding dangerous areas. This publication is important as it could enable a comparison study of zones in and around the Firefly Music Festival, campgrounds, and parking areas. If festival attendees were authorized to add information to areas they deemed hazardous or identified as having limited mobility, this may also add to the OMF experience. Geolocation also aids in the argument regarding 'platform affects' by normalizing the system construct and operationalizing the geolocation (Mitchell, Foth & Anastasiu, 2021). If "affects of trust" (specifically) can be achieved, according to Hoover et al. (2022), social groups can become desensitized to the technology at work (or what/how the device is working behind the scenes) and focus on how individuals as well as collective social groups can become acclimated, susceptible, or monetarily motivated to continue normal operations while simultaneously allowing a conduit for virtual

interfacing on said platforms (Blanke et al. 2014; Leszcynski, 2019). An established geofence prior to attendee infill also allows for the addition of Location-Based Reminders (LBR) that according to Sohn et al (2005), can be interfaced through mobile phones. LBRs could hypothetically aid in users referencing/interfacing with camping locations, parking locations, or other stationary targets. Such experiences have been validated in mixed methods research to aid in perceptions versus permissions between social groups allowing access to certain members while denying members that may not have permission through "tagging" (Ghosh & Singh, 2022). While LBRs are in a state of constant development they can and often are complicated from a design perspective as they [again] shape the experience of the user through intelligent reminders according to Draxler et al, (2022); Wang, & Perez-Quinones (2015).

## Crowd Dynamics and Crowd Analysis

Weppner and Lukowicz offered empirical evidence for estimating crowd density while using mobile phones to scan the specified environment for Bluetooth devices and achieved over 75% accuracy within their research (Weppner & Lukowicz, 2013). This pairing of technologies (geofencing, geolocation, and visual crowd analysis data) would allow command teams to view and validate real-time data regarding crowd densities and the associated abnormal behaviors that may emerge from crowd congestion amongst its participants. Such information could ultimately act as a catalyst for command or social group decisions to avoid crowd crush incidents (with risk of injuries) by providing a variety of other options (Husman et al. 2021).

Blanke et al. (2014) produced a qualitative European study to aggregate crowd dynamics using GPS and geofencing for the Swiss-based Züri Fäscht OMF in 2013,

which ultimately facilitated a greater understanding of crowd densities and crowd behavior. The authentication of the mobile app aids the study and subsequent findings through official festival promotions and its availability for download on the App Store. Of the purported 2 million attendees, the study's findings reveal that the app was downloaded 56,000 times. Of those, Android users downloaded the app 29% of the time, while iOS users contributed 71% of the data metrics. The authors collected and aggregated 25m GPS data points across 60 music stages, 130 festival area attractions, and 300 food/retail locations. While the study validates the existence of such technologies already in use (within other countries), the authors ultimately contend that "safety" (how it relates to the app) remained an abstract concept for festival attendees and therefore serves no direct benefit in that capacity.

However, this logic is not universal in its application. Yogameena & Nagananthini (2017) argue from the perspective of the Crowd Disaster Avoidance System (CDAS) (which examines crowd scene analysis, crowd behavior analysis and crowd management data sets from previous incidents), some skepticism regarding the value of CDAS safety measures in real-time. While CDAS may present findings or factors that lead to crowd crush scenarios, the authors stipulated that CDAS is inadequate to determine if a crowd crush would occur during a real-time incident; especially given that the catalyst for such events is often determined after the event has occurred (Yogameena & Nagananthini 2017). While geofencing and geolocations are not part of the established norm/portfolio for CDAS, this data could be used to validate CDAS information moving forward.

Crowdsensing (crowdsourcing data via cell participation) efficiently provides timely geolocation information, incorporating the missing variables that CDAS lacks. Burke et al. asserted that "participatory sensing will task deployed mobile devices to form interactive, participatory sensor networks that enable public and professional users to gather, analyze and share local knowledge" (2006, p.1). This application of technology can greatly benefit transportation coordination and public safety amongst other societal infrastructures (Abualsaud et al., 2018; Cardone et al., 2014; Kamel Boulous et al., 2011; Mahdi et al., 2020). That said, crowd sensing through mobile phone technologies is already possible in both participatory and opportunistic sensing methodologies. Research conducted by Ramesh, Shanmughan & Prabha, (2014) determined that by using machine-to-machine (M2M) communications through a mobile phone sensing network infrastructure and integrated with a wireless multimedia sensing network (WMSNs), participants could passively relay real-time data. Wireless Sensor Nodes (WSN) can receive and transmit digital information related to physical public safety, which in turn, facilitates physical interdiction, disruption, or remediation of the perceived threat. The authors proffered a hybrid Context Aware Computing (CAC) pairing with WSN, e.g., CAC-WSN (Ramesh, Shanmughan & Prabha, 2014). Ultimately, (for lack of a better term), “crowd logic” can be used as a universal umbrella for situational awareness regarding crowdsensing, crowd behavior analysis, and crowd management, as it would incorporate areas such as global positioning systems (GPS), accelerometer, camera, microphone, Bluetooth, gyroscope, pedometer, and traditional collectors of information such as self-reporting mechanisms (Cicek & Kantarci, 2023; Tripathi & Singh, 2016).

Public safety is particularly concerned when investigating incidents surrounding multi-day OMFs, as OMFs must balance the on-scene security presence with the festival experience. Researchers conducted two studies regarding multiple OMFs post-Route 91 Harvest Festival, Las Vegas [also commonly referred to as the 1 October incident]. Of the combined 216 respondents, 46% of participants chose unwanted security as the most selected specific concern in the study, while female respondents reported crowd violence at 50%, which was twice that of their male counterparts (Hoover et al. 2022). A mixed methods study conducted in the UK sampled 450 festival attendees which annotated "personal, social and environmental factors may increase or reduce these feelings of safety, and these are gendered" (Bows et al. , 2022. p.3). Females also reported higher numbers of sexual harassment consistent with Hoover's findings despite differences in study designs. (Bows et al. , 2022. p.3). While the cost-benefit analysis of implementing such technology would differ from one location to the next, it is essential to consider a less quantifiable matrix that includes how users perceive the festival experience and whether safety and trust play an overarching role in that experience. (Abreu-Novais & Arcordia, 2013; Al-Gaith, 2021; Blanke et al. 2014). The counterpoint would ultimately lead to less intrusive means of security and self-reporting of security needs through data extraction that capitalizes on GPS, Wi-Fi, and cell site location information (CSLI), which can override privacy concerns (Hoover et al. 2022; Khan, et al. 2019).

## Capacity of the Cellular Network

Open-source information regarding cellular network capabilities, capacities, and competencies is heavily restricted. There is a plethora of differing opinions to be found online (through open sources) regarding why one service provider may provide better service or similarity of services over a competitor, though deciphering conjecture without fact-based scientific evidence would prove useless. As of 2018, approximately 95% of Americans owned a cell phone, with 77% of the demographic owning smartphones (Talantis et al., 2020). This adaptation to smartphone technology carries with it an increase in familiarity with mobile application downloads and subsequent satisfaction which directly correlates to PEOU (Hsiao, Chang, & Tang, 2016; Kim, Yoon, & Han, 2016; Roy, 2017). Microblogging in conjunction with social media (Facebook, Instagram, Snapchat, and/or Twitter) has already served to relay information relevant to emergencies through existing web-based applications (Eriksson, 2018; Mahdi et al., 2020; Sadri et al., 2021) Though, topography may be a limiting factor in relation to connectivity (Sadri et al. 2021).

In the case of OMFs, specifically Firefly Music Festival, an established app already exists to aid in festival experience and is readily available for download on the App Store. Luxford & Dickinson (2015) acknowledged the integration of smartphones and mobile applications in the OMF setting, specifically, festival-centric adaptations which, according to Solaris (2018), is commonly referred to as 'event technology.' So long as the app has been downloaded to iOS and Android devices, the network capacity to transmit data through web-based applications should theoretically handle group sharing information despite an otherwise overwhelmed network. Longitudinal data

suggests that major cellular network providers (AT&T, T-Mobile, & Verizon) are capturing data for these events to improve the festival experience the following year. From the practitioner realm, these comparable periods can display growth through a Year-over-Year (YoY) analysis and display trends concerning peak times for service, dropped calls, or even connectivity issues through streaming.

According to Socievole et al. (2019), the research regarding Delay Tolerant Networks (DTNs) and Mobile Opportunistic Networks were validated to operate as expected in niche areas where crowds congregate. Studies show that DTNs are designed to work over large distances and in extreme conditions where the internet may be down or susceptible to high error rates. Makawana et al., (2022) compiled 134 research papers regarding DTNs to demonstrate trends through a graphical representation of DTNs' ability to serve as described. Mobile Opportunistic Networks which include Mobile Opportunistic Video on Demand (MOVi), increase peer-to-peer efficiency regarding throughput of data transfers, downloads, and live streaming (Yoon et al., 2008; Narayanan & Arun, 2014). Studies have shown that fixed network sites are unreliable between mobile devices where large crowds gather. Even with this knowledge, investigating the capacity concerning cellular networks in times of emergency is difficult for many reasons.

While public safety and emergency responders often have alternative means of communication (800MHz radios), these communications have their own set of limitations in providing timely and accurate communication (Pawelczak, et al. 2005). Limitations were quantified by several researchers to include interoperability, capacity, user competency, resource constraints, available funding for new purchases, and training on

updated systems (Martinez et al. 2010). As such, cellular networks may act as a secondary or tertiary option for public safety and emergency responders to assist with operational communication, command, and control (Abusch-Magder, Bosch, & Klein et al. 2007). Conversely, while mobile devices may facilitate interconnectivity, recent studies that utilized the attentional network task (ANT) demonstrated that mobile conversations will affect executive higher-order brain function that control cognitive behaviors. This control over executive function comes at the expense of other brain functionality. Multi-tasking and ANT demonstrated such strains can limit alerting and orientation functions of the brain (Gunnell et al., 2022).

## Privacy Concerns & the Technology Acceptance Model (TAM)

Privacy is itself contextual and can fall between legal and normative definitions. As such, privacy can have a variety of theoretical branches to support or defend each definition. Due to the underlying complexity of which aspect of privacy researchers are exploring, a comprehensive analysis found that privacy could be easily misinterpreted, misunderstood, or misquoted by the public consumer (Knijnenburg et al., 2022; Franz & Benlian, 2022). Without a clearly defined common understanding of what privacy is or is not, the terms and conditions of privacy agreements are often obscurely defined, which leads to an overly complex legal/technical perspective of permissions for how the data is gathered, transferred, stored, or sold. Privacy agreements as a result can be viewed as a hurdle, preventing the user from obtaining what they want or delaying the desired effects of satisfaction (Obar & Oeldorf-Hirsch 2020; Perera & Perera 2021). As a result, privacy terms and agreements have manifested in virtual domains as white noise or distractions whereby end-users may agree to the terms of service and privacy without ever reading the

contractual obligations or familiarizing themselves with how the data may be used (Kaul, 2017; Perera & Perera 2021). Neither author(s) mentioned that privacy could or would be misrepresented, though nefarious actors or businesses could seek to exploit privacy as a vulnerability. Hintze (2016) and Solove (2012) equally construct an argument that differentiates audiences categorically and raises a modicum of awareness regarding specialized categories, regarding both the capability and capacity of understanding amongst those accepting the agreements of privacy.

According to Communication Privacy Management Theory (CPM) "individuals regard their private information as their personal assets, that is, information that belongs to them" (Petronio, 2002, pg. 2; Schmidt et al., 2022). One unique perspective that has emerged from the work of Al-Ghaith (2021) is the inclusion of industry self-regulation within TAM when under the umbrella of CPM. When examined, the perceived privacy concerns against the antecedent's cultural values, self-defense, the context of the situation, perceived effectiveness of privacy policy, perceived effectiveness of industry, and self-regulation (Al-Ghaith, 2021). This leads to greater values for TAM in the context of independent variables. The counterpoint for arguments related to privacy reveal a paradox, albeit within different contexts, whereby individuals may claim that privacy issues and concerns are matters of importance, but actions (when subjected to academic rigor) do not support the statements of the individuals tested (Nissenbaum, 2009; Norberg et al., 2007; Obar & Oeldorf-Hirsch 2020).

One study conducted in 2020 examined the implementation of biometric technologies (BT) and facial recognition software specific to OMFs in the United Kingdom. While this is not a US-based study, the implementation of BT for events of this

type varies in scope and methodology. This study determined factors such as privacy, accuracy and reliability, none of which were found to have a noticeable impact on user acceptable (Norfolk & O'Regan, 2020). Other consistently present factors that contributed to the Technology Acceptance Model (TAM) proposed by (Davis, 1989) included "trust, compatibility, and convenience" (Norfolk & O'Regan, 2020). BT was also explored as a branch of innovative 'smart festivals' that can be expanded to include facial recognition, finger printing, iris scanning, or any combination. This idea runs concurrent with Norfolk & O'Regan's initial findings while expressing an interest to expand users' digital experience as a possible attraction (Sebata & Mollah, 2022).

The TAM can be used to extrapolate data related to attitude or social influence, specifically as it relates to norms or social standards in group behavior (Ellis & Fisher, 1994; O'Regan & Chang, 2015). TAM in its original form (without modification), as proposed by Davis et al. (1989), reasoned that the notion of key beliefs represented as PEOU and PU linked to external variables influenced by intensions. Social influence is of particular importance within social systems and may even passively rely on conformity rather than individuality (Hsu & Lin, 2008). TAM2 adds an additional scope to consider subjective norms, while TAM3 can examine the subjective norm, PEOU, PU, self-efficacy, and facilitating conditions.

The TAM model itself is recognized as a valid tool to determine acceptance of certain technologies, though other models are used interchangeably to fit with the scope of work. Critics of TAM, such as Chuttur (2009), have argued a lack of academic rigor despite the model's adaptability citing no real practical value or investiture in the model. TAM, in conjunction with Rogers' (1975) Protection Motivation Theory (PMT), should

be considered when examining respondents' backgrounds and wherewithal regarding security/privacy concerns, though this may be better suited for first responders or employees of the festival providing security. PMT offers researchers a comprehensive analysis to evaluate fear in individuals by looking at the efficacy of individual responses and/or motivators through attitudinal changes (Rogers, 2010). At present, while important this would fall outside the scope of the design for this research. Researchers in academia have utilized the Theory of Reasoned Action (TRA) or Theory of Planned Behavior (TPB) to facilitate surveys that utilize TAM, TAM2, or TAM3, though both TRA and TPB examine subjective norms and are determined by the interaction of normative beliefs and motives for compliance (Davis et al., 1989; Venkatesh et al., 2003). Unified Theory of Acceptance and Use of Technology has two versions available for application (UTAUT/UTAUT2). Each examines social influencers, effort expectancy, performance expectancy, and facilitating conditions. Dwivedi et al. (2019) constructed a compelling argument regarding UTAUT in that the UTAUT model "omitted some relationships that may be potentially important and excluded some constructs that may be crucial for explaining IS/IT acceptance and use (p.219)."

Given that the focus of this dissertation is bound to user acceptance through integrated software on iOS and Android web-based platforms, this study is of paramount importance. TAM is less about the technology itself; rather, TAM is focused on extrapolating data pertaining to users' perceptions. Convenience was found to be a major contributing factor in user acceptance (Hsu & Chang, 2013; Yoon & Kim, 2007). TAM has also seen applications to account for "fun" or hospitality functions which is an important determinant regarding the ATU (Saber-Chtourou & Souiden, 2010). It is also

prudent to keep in mind that the TAM model cannot be applied universally across all studies. For example, Determe et al. (2022) explored passive crowd monitoring with integrated Wi-Fi signals to track crowds, though the lack of individual interface and comprehensive understanding may create bias by individual users.

Passive controls such as mobile ticketing and radio frequency identification (RFID) wristbands (which later evolved as a secondary source of virtual payment methods) have already been introduced by festival promoters to both enhance and expedite the user experience into the festival while simultaneously restricting fraud, waste, and abuse (Hudson & Hudson, 2013; Patchen, 2015; Van Winkle & Bueddefeld, 2020). While one could hypothesize that a semi-conscious act is occurring when patrons sync credit card information while interfacing with a product or service, the current frequency of online/mobile payments and streaming services – in addition to the trust users may have with companies or institutions – may invalidate the 'conscious act' in-part or altogether. What can be assumed is that the usefulness of the product/service or the user experience while in attendance outweighs the risk to privacy.

Perceived Ease of Use was defined [originally] by Davis (1989) as "the degree to which a person believes that using a particular system would be free of effort." Meanwhile, Perceived Usefulness (PU) in relation to (TAM) found in Saadé and Bahli (2005), argued that usefulness is a key factor in determining if one will elect to embrace the technology through actual use (AU). PU influence over AU was again confirmed as relevant and scalable by Talantis et al. (2020) when determining participant acceptance of mobile application technology in relation to TAM. Those in academia, or practitioners seeking to apply TAM in common practice should view Norfolk & O'Regan, (2020) and

Saadé & Bahli (2005) collectively to avoid misconceptions regarding TAM with the community they intend to serve.

Research by Lemay et al. (2017) validated the position of convenience over other privacy concerns and restrictions. While Ho et al. (2003) elected to use variables of "intention" in conjunction with PEOU, Norfolk & O'Regan (2020) found some measure of inconsistency in universal availability to technological systems. This research concurs with Norfolk & O'Regan's assessment and adopts Attitude to Use (ATU) as an acceptable variable for measurement. Abandoning intention for attitudinal approaches may clarify positions with respect to availability of BT, though it will not solve issues related to respondents who may not be familiar with the technology deployed at music festivals, which may also invalidate future research (Norfolk & O'Regan, 2020).

When looking at web-based applications (which use the internet for possible exchanges of information) such as Facebook, Instagram, or Snapchat, findings demonstrated that needs or even social inclusion would outweigh the overarching concern of privacy. Cousineau, Oakes, and Johnson (2018) asserted the current generation embodies an epistemic curiosity regarding the current "apps" culture which can be shared as a social trait and passed on to future generations until such time where application-based software is commonplace across all demographics. According to Roy, (2017) and Wang, Liao & Yang (2013) mobile apps enable users who are immersed in the apps culture to satisfy both "hedonic and utilitarian" needs based on the type of app that is downloaded (Wang et al. , 2013, pg. 13). While neither author accounts for privacy related issues within their own independent studies, Roy does clarify privacy as an area for future research with TAM related work.

Accessibility to information and leisure regarding the IoT may act as a catalyst in the Typology of Human Capability (THC) (Brown et al., 2020; Van Winkle, MacKay & Halpenny, 2018). Studies have confirmed that younger demographics of both male and female participants (particularly millennials) are more likely to share their personal data (Khalaf, 2015; Taraszow et al., 2010). Meanwhile, due to significant growth in the Internet-of-Things (IoT) domain, accessibility of app-based information has moved beyond computers and phones and can now include smart watches or even smart cars (Belkhouja & Doppa, 2020). Within this review, none of the authors outright discuss desensitization or accessibility to mobile devices, nor the PEOU versus the role of perceived risk in consumer behavior.

Some researchers present confounding arguments regarding social media platforms during music festivals, specific to music festivals in New Zealand. In-depth interviews illustrated that participants may not actively engage in using multi-media while in attendance and attributed this to a passive festival experience, though the research used a smaller sample size that may not reflect the whole of music festival attendees (Hoksbergen & Insch, 2016).

Regan, Brookshire, & Harris (2015) examined a small sample size of 115 participants and determined that respondents may have become desensitized to privacy permission queries when downloading web-based applications on popular multimedia devices. Several authors expounded further to forewarn those new methods of explaining privacy settings may fall short of expectations due to a failure to read the terms and agreements (Felt et al., 2012; Mylonas et al., 2013; Regan, Brookshire, & Harris, 2015). This directly supports the earlier argument of Hsu & Chang (2013) and Yoon & Kim

(2007) regarding consumer convenience being the greater factor in what level of risk consumers are willing to accept. While this argument is powerful on its own, it also harkens back to another prior argument regarding the social group as a whole and potentially social influence within said social groups as being more important than potential lapses in privacy.

## Social Groups, Help-Seeking Models, & Recovery

Gist & Lubin (1999) discussed [at length] individual and group-shared experiences with traumatic events and how each might recover. While there are aspects of SNT inter-spliced within the work (meso perspective), both shared social identity and Lewin's Equation reinforce the notion that social groups will seek immediate reassurances/guidance from within their social circles. This phenomenon is indicative of a cohesive identity which may present as early as the response to the event (Cocking, 2013). The argument for such inclinations is backed by empirical evidence which affirms through an affiliation model that under threat, individuals within a social group will seek the familiarity of group membership in search of a cohesive bond, even under the threat of individual demise (Drury et al. 2009; Sime, 1983). Research suggests that both SIT and shared social identity is indeed appropriate to conduct research pertaining to help-seeking behaviors (Cocking, 2013; Drury, 2018; Drury et al., 2019; Levine & Manning, 2013; Zaki, 2020). Gist and Lubin justified this perspective by outlining those individual realities. By extension, the individual reactions become part of the shared social identity fabric with which the audience shares membership due to the event. Ultimately, this collective of individuals and social groups manifest a purposeful or happenstance coping community (1999). While the authors make these assertions, no study could be found to

quantify group leaders (inter/intra) and their roles (if any) in the establishment of coping communities within the context of OMFs. Drabek (2018), shared insights regarding social affiliation related to helping behaviors post incident that "a majority of victims will begin rescuing and helping any who might be around them" (pg.153). Wakefield and Hopkins (2017) examined three distinct "social strands" related to both offering assistance and rendering assistance for both ingroups and outgroups. The authors contend that a group's image-related concerns are at the center of perception-based interactions and the shared social identity present in the members.

To emphasize the role of social influence and personal perceptions in help-seeking behaviors, one must first perceive that an incident is occurring outside the context of what is considered normal behavior, recognize/interpret the information, and compel action or inaction on the part of the individual or group (Bartlett, 1932; Fiske & Taylor, 1991; Gist & Lubin, 1999). Preexisting social cohorts, variables, broad social attachments, interactions with others, and previous similar experiences can influence these internal and external relationships (Chu et al., 2014; Mawson, 2005; Raphael, 2005). However, in the context of what can be perceived by either ingroup or outgroup members, and more importantly, a conveyance of trust, Offerman (2002) suggested that the intentionality of the action, be it positive or negative, matters most. The general view from academia is that this argument is valid and widely accepted. The Offerman study explicates that 25% of respondents were more likely to aid others when the actions were perceived as intentional rather than how the situation unfolds and the actions of individuals are regarded as happenstance. Emotional investiture was also found to influence the difference in perceptions (Offerman, 2002). While not within the scope of

the research, this intentionality typology may lead to a greater understanding of how individuals from separate groups may be inspired to assist. Capitalizing on the emotion of help-seeking behaviors and while remaining cognizant that the emotions of a real-world settings may have cascading effects as well as risks on those that perform or benefit from the action, Li and Xie (2017) modernize an antiquated argument regarding altruistic acts and helping behaviors, in that the acts might simply manifest from selfish motivations. These seemingly altruistic acts might even result in unintended consequences for the performers of said actions (Batson, 2010; Reykowski & Smolenska, 1980). The authors contend that the intangibles surrounding motivations "may simply be the result of the performer seeking to alleviate feelings of physical burdens" (Xi & Xie, 2017. p.189).

# CHAPTER 3: METHODOLOGY

Phenomenological studies are generally qualitative in nature, because they explore human behavior to find meaning in inherent phenomena that people view as obscure. This dissertation explores the phenomenon of natural instinct(s) and the plausibility of its overriding power during an emergency. The study applies Lewin's equation of human behavior - the theory that behavior is the function of social groups and the influence of their environment - and how the instinct for group members to [prematurely] reunify during a no-notice evacuation specifically overrides the ingrained lesson to listen to authoritative direction.

This study aims to understand more specifically not only how likely it is that OMF attendees will/will not adhere to authoritative direction during an evacuation, but also how well attendees will listen to that authority, which advises singular myopic direction(s) absent the social group's priorities (directing festival attendees to reunify at established reunification centers). This study applied a dually quantitative and qualitative survey to festival attendees of previous Firefly Music Festivals from 2012 -2022, while omitting 2020 data due to cancelation. Utilizing a combination of primarily closed-ended, hierarchal ranked responses and open-ended questions, the study sought to understand the receptiveness of attendees utilizing a modified Firefly Music Festival app (with geofencing and geolocation software) to quell attendees' unease about being separated from social group members during a time of uncertainty by providing peace of mind regarding their groups' location.

The author determined that Davis's original Technology Acceptance Model was acceptable for assessment and was selected to determine if and how a modified web-

based application accessible on both Android and iOS platforms could aid social groups in reunification efforts. Since its inception, TAM has undergone various modifications regarding external variables' usefulness. ATU, AU, and PU can still be linked back to Davis's original (1989) intent, though PEOU required modifications as external factors such as social influence (SI) and situational/spatial awareness (SSA) were considered for inclusion, which are again predicated on both the physical and virtual realms. Facilitating peer-to-peer or peer-to-selected-services via Android and/or iOS mobile apps is no longer a new or even innovative concept. Mobile app software can run simultaneous taskings while in active or dormant states of readiness, which (every day) users have grown to accept or become accustomed to. This study contends that the external variable (SI) influences PEOU, which in turn indirectly affects PU. The external variable SSA directly affects PU. Therefore, the external variables SI and SSA specifically influence PU, respectively as conduits for changing the ATU (and ultimately AU). Prior studies indicated TAM can be successful in predicting user acceptance (Carroll, 2016; O'Regan & Chang, 2015).

**Figure 2**

Davis Original Technology Acceptance Model

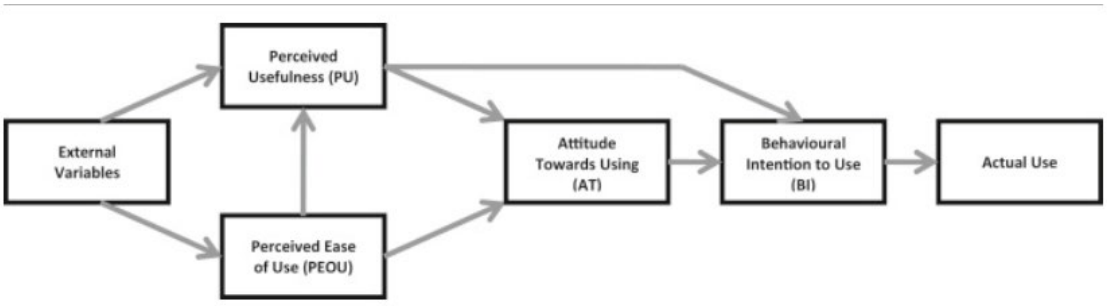


**Figure 3**

Modified Technology Acceptance Model

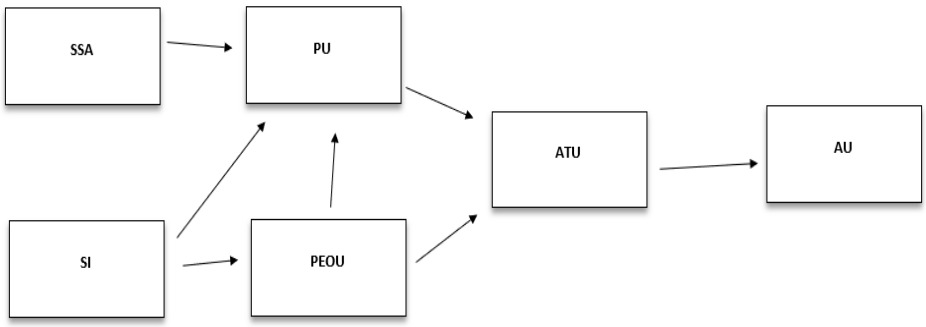
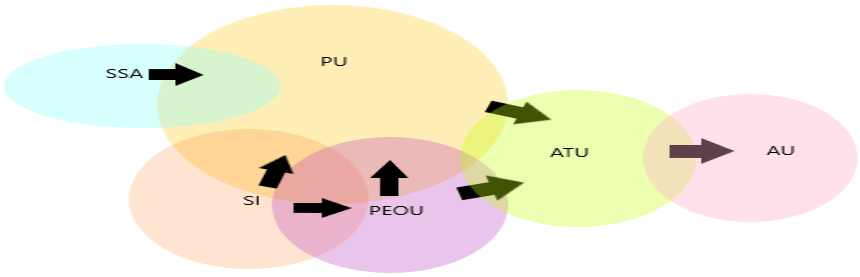



**Figure 4**

Euler Diagram of Integrated Relationship within a Modified Technology Acceptance Model




A survey was administered to previous Firefly Music Festival attendees to examine their level of situational awareness while attending the event, and to collect their input regarding how technology can assist in fighting the urge to delay evacuation. This survey consisted of 28 close-ended questions and four open-ended questions that were later coded based on predetermined themes. Descriptive statistics provided a way to

quantify data supplied by the close-ended survey feedback, and inductive, thematic analysis was applied to identify patterns in open-ended, qualitative responses. This hybrid approach permitted a mixed-methods study. Inductive analysis is a process where similar responses are grouped into emergent categories that are identified in the data itself, rather than sorted into predefined categories (Terry et al., 2017). This method of thematic analysis was used to minimize the influence of researcher preconceptions on the findings while enabling unanticipated insights to emerge, as recommended by Merriam and Tisdell (2016).

## Comparison with Previous Work

Overcoming obstacles such as end users' motivation or ATU within TAM have been noted in previous work (Schaefer et al., 2016), which specifically examined physical activity. This author rejects this obstacle, as the modified TAM acts passively in relation to what the social group elects to do while attending an OMF. Schaefer was also keen to point out that PU could be negatively affected by a factor of time and novelty (2016). This consideration is noted as a concept regarding the modified TAM proposed within this study. However, when factoring SI into the TAM, one can begin to validate the social group(s) exercising its influence over individuals to capitulate within the sphere of PEOU or PU, which may be dependent on the argument for conformity. Individual choice was also a factor in this study and was covered in the literature review purposefully as it has been validated as an important modifier based on interviews with respondents when applied to SocEvac modeling (Best, 2013).

Norfolk and O'Regan (2021) holistically examined the implementation of biometric technologies (e.g. fingerprint recognition, facial recognition, and iris scanning)

at music festivals while applying a TAM model. While there is no overlap present between the two studies, matters of festival attendees' privacy and attendees' subsequent attitudes towards said privacy are important parallels for consideration and support areas of future research suggested by Roy (2017).

Kamel Boulos et al. (2011) and Ouyang et al. (2013) discussed the advantages of a crowdsourced incident reporting tool utilizing smartphone technology. This is comparable to the hypothetical reporting function proposed in this research by the author for use in the Firefly Music Festival app. While Ouyang et al. (2013) nonionized the PEOU regarding the iSee software, the PEOU, which would support the ATU and, ultimately, PU, was not rigorously tested. Furthermore, this iSee app (which does utilize GPS location and timestamps) acts as a separate app, not self-contained/imbedded within a specific multi-purpose setting that users would have access too because of an event they are attending.

Blanke et al. (2014) produced a qualitative European assessment regarding the Swiss-based Züri Fäscht OMF in 2013. Similar to Kamel Boulos et al. (2011) and Ouyang et al. (2013), the authors' work abstains from using any facsimile of a TAM or ATAUT to ascertain the likelihood of ATU or AU with regards to deployment of a mobile application that utilized geo-fencing and GPS tracking of festival attendees. Blanke et al. (2014) in conjunction with festival promoters developed the mobile app for download/use on Android and iOS platforms however, the study's overall goal differs in that the research did not function and was not tested as an evacuation/reunification tool. No studies have used TAM while incorporating social influence and situational/spatial

awareness of pre-existing software applications and how they might affect evacuation/reunification processes could be found.

**Table 1**

Group A1

| Code | SQ1 | SQ2 | SQ3 | SQ4 | SQ5 | SQ6 | SQ7 |
|---|---|---|---|---|---|---|---|
| 1 | Male | 18-24 | Married | Yes | Yes | Local | Yes |
| 2 | Female | 25-34 | Widowed | No | No | Hotel | No |
| 4 | Non-binary | 35-44 | Divorced | | | Camping | |
| 5 | Prefer to self-describe | 45-54 | Separated | | | Airbnb | |
| | | 55-64 | Cohabitation | | | | |
| | | 55-64 | | | | | |
| | | 65+ | | | | Other _____ | |

**Table 2**

Group A2

| Code | R1/Q1 | R1/Q2 | R1/Q3 | R1/Q4 | R1/Q5 | R1/Q6 | R1/Q7 | R1/Q8 | R1/Q8A |
|---|---|---|---|---|---|---|---|---|---|
| 1 | Knowledge of the situation | Yes | I would move to an area outside the festival where I feel safe | I would evacuate and move to an area I felt safe | I will get in my car/ Uber/ Lyft and leave the immediate vicinity | Call friends tell them where to meet | If I have keys, I will immediately get in the car and drive away | I stop to help them if I feel that I have the training | I will keep and protect the injured until I find law enforcement or medical aid |
| 2 | Seriousness of the situation | No | I would move to an area inside the festival to avoid the crowds | I would delay my evacuation to find missing group members | I would try to call/text my friends inside to make sure they are okay | Text friends that I am okay and where to meet up | I will hide (tent or car) | I stop to help them if I feel it is safe | I will keep and protect the injured until I feel as though we are all safe |
| 3 | Influence of other attendees actions | | I would delay until I was officially told by the festival (announcement) to evacuate. | I would follow the instructions provided by the festival | I would find local law enforcement/ security to find out more information | Get to safety and worry about my friends when I am safe | I will run towards an exit? (campsites have exits) | I stop to help them because I feel I should | I will keep and protect the injured until I find my social group |
| 4 | Perception of other attendees' actions | | I would make my way towards a known link up spot my group established in case we got separated. | I would move to a known link up spot my group established before the incident | I would make my way over to an established reunification center | Look for festival security or local law enforcement to protect me | I will try to text call my friends to warn them | I try to reassure them but do not render physical assistance | I will keep and protect the injured until I can get them to an established relocation center |
| 5 | Technology to gain more information | | I would focus on finding the last known group member who had keys to the vehicle we arrived in. | I would delay, and call/text to find out what my friends were doing (where they were going). | I would wait outside the festival to see if I could locate my friends | | | I continue looking for my social group | I will keep and protect them until they hinder my own safety |
| 6 | | | | I would focus on gathering my belongings from my car/campsite | | | | I would not acknowledge them | |

**Table 3**

Group A3

| Code | R2/Q1 | R2/Q2 | R2 Q3 | R2 Q4 | R2 Q5 | R2 Q6 | R2 Q7 | R2 Q8 | R2 Q9 | R2 Q10 | R2 Q11 | R2 Q12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Yes | Before festival | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| 2 | No | Arrived at festival | No | No | No | No | No | No | No | No | No | No |
| 3 | | During festival | | | | | | | | | | |

**Table 4**

Group B

| CODE | R3/Q1 | R3/Q2 | R3/Q3 | R3/Q4 | R3/Q5 | R3/Q6 | R3/Q7 | R3/Q8 | R3/Q10 |
|---|---|---|---|---|---|---|---|---|---|
| 1 | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| 2 | No | No | No | No | No | No | No | No | No |

**Table 5**

Connections of Hypothesis to Research Questions and Analysis

| Hypothesis | Research question | Survey Question | Level of Measurement | Method of Analysis |
|---|---|---|---|---|
| N/A* | R1. What is the overall level of Perceived Usefulness, Situational Spatial Awareness, Social Influence, Attitude towards Use, Actual Use, and Perceived Ease of Use for existing application-based software technologies on Android and iOS platforms to facilitate user | *Perceived Usefulness:* q0007, q0008, q0023 q0024 q0026 q0027 q0030 q0031 q0032 q0010_0001 q0010_0002 q0010_0003 q0010_0004 *Situational Spatial* Awareness: q0011 | Ordinal | Descriptive statistics of frequencies and percentages |

| | | | | |
|---|---|---|---|---|
| | expectations of reunification efforts for pre-planned or spontaneous evacuations of Outdoor Music Festivals (OMF)? | q0012_0001 q0012_0002 q0012_0003 q0012_0004 q0012_0005 q0013_0001 q0013_0002 q0013_0004 q0013_0005 q0014_0001 q0014_0002 q0014_0003 q0014_0004 q0028 *Social Influence:* q0012_0004 q0012_0005 q0014_0005 q0015_0001 q0015_0002 q0015_0003 q0015_0004 *Attitude towards Use:* q0033 q0025 q0020 Actual Use: q0019 q0022 Perceived Ease of Use: q0021 | | |
| H1. There is a significant relationship between perceived usefulness (PU) and the attitude toward use (ATU) of hypothetical crowd-connected software for situational/spatial awareness and reunification efforts for social groups | R2. What is the relationship between perceived usefulness (PU) and the attitude toward use (ATU) of hypothetical crowd-connected software for situational/spatial awareness and reunification efforts for social groups that interface through Android and | *Perceived Usefulness:* q0007, q0008, q0023 q0024 q0026 q0027 q0030 q0031 q0032 q0010_0001 q0010_0002 q0010_0003 q0010_0004 *Attitude towards Use:* | Ordinal | Chi-Square test and SEM |

| | | | | |
|---|---|---|---|---|
| that interface through Android and iOS platforms. | iOS platforms? | q0033 q0025 q0020 | | |
| N/A | R3: To what extent can the current Firefly mobile app technology be modified to serve the function of situational awareness using geofencing and geolocation for OMF attendees? | Survey items from a sample of SMEs | Ordinal | Descriptive statistics of frequencies and percentages |

In the defined timeframe, two weather-related, full festival evacuations occurred at Firefly Music Festival (CY2015 & CY2022). Festival promoters, incident command team members and emergency response partners conducted one weather-related tabletop exercise (CY2021), which shared similarities to the Indiana State Fair stage collapse in 2011. The tabletop exercise conducted in 2021 focused heavily on first/emergency responders' response(s), public information, messaging and warning, and uncoordinated evacuation. Following in-person observations, the author conducted follow-up interviews with Dover Motor Speedway (DMS) key leaders and AEG Presents staff. Using Firefly Music Festival and the surrounding campsites associated with the festival in Dover, Delaware, this dissertation aimed to gauge user acceptance of geofencing and geolocation software to aid social groups' reunification efforts regarding a no-notice evacuation event. Hospitality questions, which would aide in the festival experience, were also asked in order to determine the likelihood of user acceptance and overall usefulness of the Firefly Music Festival app.

By applying the findings of this study, academia, public/private sector partners, and music festival attendees will have the necessary knowledge to prepare strategies to deter crowd disasters, construct new and innovative best practices for communicating during an evacuation, facilitate reunification of social groups in a timely effective manner, aid in their psycho-social recovery, and diminish damage to private sector reputations.

## Research Questions

This study addressed the following research questions:

$R_1$. What is the overall level of Perceived Usefulness, Situational Spatial Awareness, Social Influence, Attitude towards Use, Actual Use, and Perceived Ease of Use for existing application-based software technologies on Android and iOS platforms to facilitate user expectations of reunification efforts for pre-planned or spontaneous evacuations of Outdoor Music Festivals (OMF)?

$R_2$. What is the relationship between perceived usefulness (PU) and the attitude toward use (ATU) of hypothetical crowd-connected software for situational/spatial awareness and reunification efforts for social groups that interface through Android and iOS platforms?

$R_3$: To what extent can the current Firefly mobile app technology be modified to serve the function of situational awareness using geofencing and geolocation for OMF attendees?

In order to measure the study variables of Perceived Usefulness (PU), Perceived Ease of Use (PEOU), Actual Use (AU), Situational Spatial Awareness (SSA), Social

Influence (SI), and Attitude Towards Use (ATU), a survey asked the following questions depicted in Table 6.

**Table 6**

Question Items of Survey

| Measure | Item |
|---|---|
| Actual Use | Before downloading the Firefly Music Festival app, did you read the Privacy Terms and Conditions? |
| Actual Use | When did you download the Firefly Music Festival app? Choose the answer that best describes your experience. |
| Attitude Towards Use | Would you be willing to allow the Firefly Music Festival App to access the same data as Facebook, Instagram, Snapchat, WhatsApp, and/or Twitter, if it aided in your perception of increased safety or security for yourself and your group? |
| Attitude Towards Use | Every year, thousands of people attend Firefly. Would you have any interest in the ability to join additional social groups via the Firefly Music Festival App to track new friends' locations during the festival? |
| Attitude Towards Use | Would you be willing to allow the Firefly Music Festival app to access the same data that apps such as Facebook, Instagram, Snapchat, WhatsApp, and/or Twitter do, if you found value in the app? |
| Perceived Ease of Use | Did you personally utilize the Firefly Music Festival Mobile App during the festival? |
| Perceived Usefulness | Did you travel/arrive with friends to Firefly Music Festival? |
| Perceived Usefulness | Did you meet up with friends after arriving to Firefly Music Festival? |
| Perceived Usefulness | Would you be more likely to utilize the app if you could view/follow your friends' current location within the festival? |
| Perceived Usefulness | Would you be more likely to utilize the app if you could view/follow your friends' location within the festival campground? |
| Perceived Usefulness | If the modified Firefly Music Festival App provided a "pin location" to mark your campsite or areas of interest, how likely would you be to use the app? |
| Perceived Usefulness | If the Firefly Music Festival App was able to show key areas (such as medical tents, relocation centers, lost and found locations, or cell phone charging stations) in relation to your location, would you be more likely to use the app? |
| Perceived Usefulness | If the Firefly Music Festival App provided you with pre-staged ridesharing/bus locations in relation to your location, would you be more likely to use the app? |

| | |
|---|---|
| Perceived Usefulness | Would you be more likely to use the Firefly Music Festival App if you could interact with your friends through it with a text/messaging function? |
| Perceived Usefulness | While at Firefly Music Festival, your friend calls you worried about their safety. You can see their location through the Firefly Music Festival App. Would you find it beneficial if the app also had a function where you could relay this information to security? |
| Perceived Usefulness | Knowledge of the situation (authority providing details) |
| Perceived Usefulness | Seriousness of the situation |
| Perceived Usefulness | Influence of other attendees (witnessed actions/communications) |
| Perceived Usefulness | Having accessible information (technology) |
| Situational Spatial Awareness | I would move to an area outside the festival where I felt safe |
| Situational Spatial Awareness | I would move to an area inside the festival to avoid crowds |
| Situational Spatial Awareness | I would delay and wait for festival instructions |
| Situational Spatial Awareness | I would delay, call/text to find out what my friends were doing (where they were going) |
| Situational Spatial Awareness | I would focus on packing up my belongings and leaving |
| Situational Spatial Awareness | I would move to an area outside the festival where I felt safe |
| Situational Spatial Awareness | I would move to an area inside the festival to avoid the crowds |
| Situational Spatial Awareness | I would immediately follow the festival's instructions |
| Situational Spatial Awareness | Do you trust authority's instructions enough to listen/follow without making contact with your friends/group during an evacuation prior to reunification? |
| Situational Spatial Awareness | Leave the immediate vicinity |
| Situational Spatial Awareness | Try to text/call my friends to make sure they are okay |
| Situational Spatial Awareness | Locate law enforcement/security to find out more information |
| Situational Spatial Awareness | I would make my way over to the reunification center |
| Situational Spatial Awareness | Do you remember seeing any signage regarding evacuation routes during your time at Firefly Music Festival? |
| Situational Spatial Awareness | When you attended Firefly Music Festival, did you know where the relocation center was located in the event of a planned or unplanned evacuation? |
| Social Influence | I would delay, call/text to find out what my friends were doing (where they were going) |
| Social Influence | I would focus on packing up my belongings and leaving |
| Social Influence | I would wait outside the festival to see if I could locate my social group/friends |
| Social Influence | Call friends, tell them where we can meet |
| Social Influence | Text friends, tell them where we can meet |
| Social Influence | Get to safety first, call/text when I feel I am safe |
| Social Influence | Look for festival security/law enforcement to protect me |

The responses to the survey items were measured on a nominal scale, thus, the analysis for research questions one and two of the study comprised of conducting descriptive statistics of frequencies and percentages as well as Chi-square tests to assess the relationships between perceived usefulness (PU) and the attitude toward use (ATU). Additionally, for research question three, a sample of 12 SMEs participated in a survey to assess the Firefly App's ability to be modified and measure perceptions of geofencing, geolocation, tracking capabilities, and privacy.

The author sought to determine if the app could be successfully modified to track social groups' locations in research question #3, by soliciting FEMA HQ subject matter experts within the Science and Technology Division. The survey sought answers to the following: Can the current Firefly Music Festival App design and configuration be modified? Could the Firefly Music Festival App be modified to include geofencing/geolocation updates of festival attendees' locations? Would geofencing and geolocation additions alter the already established privacy policy settings for the Firefly Music Festival Mobile App? Can mobile apps be modified to allow social groups to track each other's location(s) and display said location(s) over a map feature? Can mobile apps be modified so that users can drop a pin on their location, accessible only by other users within the same social group? Can mobile apps be modified in such a way that would allow for pre-identified locations to be dormant or active as the situation dictates by the Command Team? Would location tracking alter the already-established privacy policy settings for Firefly Music Festival Mobile App users? Can users' interface with a modified app to directly raise concerns (e.g., suspicious persons, unconscious individual, bus location, Uber/Lyft location, medical or EMS locations, etc.) to designated law

enforcement/security personnel? The researcher added a disclaimer to the previous question to provide more context/clarity. Disclaimer: *Appropriate directives/responses would be given by Firefly personnel in response to messages received based on relevance, their relation to health and safety, urgency level, and perceived impact.* How likely is it that the app can be modified so that individuals within social groups can simultaneously share their location with multiple (other) social groups? Could modifications to the existing Firefly Music Festival app support a text function between members within the social group? Would adding a text function within the Firefly Music Festival App alter users' established Privacy Policy settings? From a Science and Technology perspective, how valuable would geolocation/geofencing data for festival attendees be for the Incident Command team in providing a real-time operational picture? From a Science and Technology perspective, if an incident were to occur at an Outdoor Music Festival prompting an evacuation, could geolocation/geofencing software potentially aid first/emergency responders in locating lost or missing individuals? The previous question also required some context/clarity after sample testing within the FEMA Science and Technology branch required more specific information. Disclaimer: *This question applies the "Run, Hide, Fight" model and presupposes that some festival attendees will attempt to hide if they feel safe in doing so.* With respect to Soft Targets/Crowded Places and situational awareness, do you see value in a social group's ability to access each other's location where the possibility of planned, unplanned evacuations exists? Post evacuation: If an Incident Commander decided to establish a reunification center for evacuees, would it be helpful to pin the location (within the modified app) for attendees that may not be familiar with the surrounding area outside the

festival grounds? Suppose social groups were empowered through the hypothetical modifications to the existing Firefly Music Festival app. How likely is it that the mobile app (with modifications) can reduce the potential capacity of expected persons requiring an official reunification center?

## Research Methodology

This mixed methods study utilized a web-based survey of festivalgoers, specific to Firefly Music Festival attendees, who were assigned the designation Group A. The Federal Emergency Management Agency (FEMA) Headquarters (HQ) (Science and Technology Division) was assigned the designation of Group B. Five standardized, closed-ended questions were administered to all participants in Group A, which consisted of consent, gender identification, age demographics, sexual orientation, and marital status. Race was not considered as a factor for inclusion as social groups can transcend the boundaries of ethnic origin. Answers were provided with a code for quantitative analysis. Within the same survey, Group A was immediately prompted to answer 28 qualitative survey questions which sought to determine both if and how festival attendees utilized mobile technology (specifically the Firefly Music Festival app) while in attendance of an Outdoor Music Festival (i.e. socially or informative) and if technology could assist in situational awareness of group members locations which may in turn aid in reunification through structured surveys.

Group B's survey included seven yes/no questions and ten Likert scale questions interspersed throughout the survey of hypothetical modifications regarding geolocation and geofencing technology that could be utilized to enhance the mobile Firefly Music Festival App. Respondents were also provided with AEG Presents 2022 Privacy Policy

for review. At the time of the study, the 2022 Privacy Policy was the most current version. Given the parameters of this mixed methods study, user interface and familiarity with the Firefly Music Festival app during the festival were determined through structured surveys to assist in the development of a baseline understanding regarding OMF attendees' ability to utilize their maximum potential to both maintain situational awareness of the location of social groups and aid in reunification efforts through a medium such as the software application. Survey responses for both groups were collected all at one time from April 2023 through June 2023 during peak upcoming OMF schedule release dates and Summer OMF social media awareness campaigns.

## Operationalizing and Conceptualizing Research

In order to precisely define how the variables were measured and ensure the attributes within those variables are mutually exclusive and exhaustive, this research distributed surveys through the Survey Monkey platform to "Firefly Music Festival Fan Page" with 22k members, "Firefly Music Festival Fan Page for EVERYONE" with 1.9k members, and "Firefly Fan Page LGBTQIA" with 264 members. A link was also embedded on the final page of the survey, encouraging participants to forward said survey to their social group, thereby maximizing the survey's potential reach. This bottom-up approach differs from the normative top-down approach. The target audience of research questions 1 & 2 were festival attendees. Group A participants comprised various modalities such as attendees with a single-day pass, multi-day pass, camping, Airbnb/Vrbo, hotel/motel, local residents, and those that stayed with friends/family. The target audience of research question 3 was the Federal Emergency Management Agency (FEMA) Science and Technology Branch subject matter experts, which was inclusive of

Soft Targets Crowded Places (ST/CP) subject matter experts, and a separate division under Alerts and Warnings; also derived from subject matter experts within the specified field.

Group A data ranged in demographics and festival attendance by type, response to evacuation notification, no notice evacuation thought processes, trust, and social interaction during the evacuation, including helping behaviors. Coded data included the evacuees' gender, age, and ranked the response of festival attendees' choices relative to survey questions. Group A data also included responses to open-ended questions, which the participants answered in their own words. Data from open-ended questions were coded using an inductive, thematic procedure. Definitions for operational variables are provided in Table 7.

**Table 7**

Operationalization of Independent Variables

| Variable | Operational Definition |
|---|---|
| Physical Social Influence | Physical social influence refers to the process by which individuals are affected or influenced by the actions, behaviors, and opinions of others in face-to-face interactions and real-world settings. This influence occurs when people observe, interact with, and are guided by the actions or attitudes the individual encounters in their physical environment. This includes aspects of conformity, peer pressure. |
| Virtual Social Influence | Virtual social influence involves the way individuals are influenced by the actions, opinions, and behaviors of others in a virtual setting e.g., online, chat rooms, social media, mobile applications, and asynchronous communications. |
| Physical Situational Spatial Awareness | Physical situational spatial awareness refers to an individual's or a system's ability to |

| | |
|---|---|
| | understand and perceive their surroundings and the spatial relationships between objects, people, or entities in the physical world. It involves being aware of one's physical environment, including its layout, the location of objects, obstacles, and people, and having a sense of one's own position and orientation within that environment. |
| Virtual Situational Spatial Awareness | Virtual situational spatial awareness refers to the ability of an individual or a system to understand and perceive their surroundings and the spatial relationships between objects, people, or entities while interfacing with an online platform/virtual environment. |

*Note:* Table 7 provides the operational definitions for key terms used throughout the dissertation. The terms are intended to be used interchangeably for situational settings.

## Data Collection

This study design was engineered to utilize a mixed-method approach. Data extraction utilized exponential non-discriminative snowball sampling as this method was determined to be the most applicable and is used when an initial subject chosen by the researcher recruits multiple other subjects which also fit the parameters of the targeted population. Each of these recruited subjects subsequently initiates multiple other subjects, and so on and so forth. Ideally, this creates an eventual geometric map of exponentially increasing subjects, all which fit into the researcher's parameters of study. Snowball sampling is often utilized to attain feedback from difficult-to-reach populations due to its social nature (Berg, 2006; Dusek et al. , 2015). An element of trust is inherent in snowball sampling that is not necessarily present in other methods of data collection. This element of trust facilitates a culture of openness between the researcher and his/her subjects, and without it the information gathered through this survey-type would otherwise be unattainable. The intent of this dissertation is to collect data from a social

event (Firefly Music Festival), and while that population is not particularly difficult to track or contact, is it social in nature. By reframing the usual logic acted upon in snowball sampling, but following the same template it provides, this social information-collection technique can be repurposed to aid in the collection of data from an OMF. Ergo, snowball sampling is the most apparent method to appropriate for this dissertation.

## Data Collection Instrument

An online survey will be used for this study (See Appendix A) through the platform Survey Monkey. According to Dusek et al. , (2015) data collection and information exchanges should be familiar and commonplace with the population surveyed, to facilitate a more inclusive conversation. Such surveys (post COVID-19 pandemic) are more common than perhaps previous studies, and the PEOU when selecting Survey Monkey as the preferred platform accounts for the AU for a self-administered questionnaire.

The survey consists of a demographics section which will include questions on the participant's age, sex, and marital status. Additionally, the next section will include five-point Likert-like items that will measure perceived ease of use (PEOU), actual use (AU), attitude towards use (ATU), situational/ spatial awareness (SSA), perceived use (PU), and social influence (SI).

## Instrument Validation Process

Validation is instrumental to ensure that the work product is of such standard that it can withstand counter arguments from social perspectives and survive academic rigor through integrity due to content validation. Since the data collection process is primarily qualitative, which can be construed as interpretable, it is pertinent to ensure that the

information being gathered is thoroughly answering the posed research questions prior to translating it to quantitative data (Bollen, 2002). In order to validate the surveys used for both Groups A & B in the study, the author ascribed to the expert validation process proposed by Elangovan & Sundaravel (2021). Survey questions were developed for the target audience in both Group A & B using Survey Monkey.

The author developed one primary point of contact for subject matter experts Through FEMA HQ Science and Technology division. Email and telephonic coordination calls confirmed a sample size and willingness to voluntarily serve on the subject matter expert review panel. The verbiage from the Introduction Letter to subject matter experts [Group B], (Appendix X) was pasted into the body of the referenced email. Subject matter experts were selected to test the survey questions using the seven-step scale development. The scale construction encompassed (1) Item Generation, (2) Content Adequacy Assessment, (3) Questionnaire Administration, (4) Factor Analysis, (5) Internal Consistency Assessment, (6) Construct Validation and (7) Replication; proposed by Hinkin et al. (1997). Once submitted to the review team, feedback was gathered concerning the content-oriented evidence, or the relationship between the test and variable of measurement and incorporated into the finished survey. Quantitative data generated through SPSS includes a self-validation function by either basic variable checks or single variable validations. Once complete, subject matter experts were sent individual emails with a copy of the link to the survey. The survey was rendered dormant after all the survey responses were collected.

## Instrument Validation Results

The survey instruments were distributed to the sample that represented the target group. A mixed methods pilot study allowed for feedback not only respective of survey designs but also respective of the TAM model inclusion. Modifications to the survey questions were made for clarity upon request of the subject matter experts.

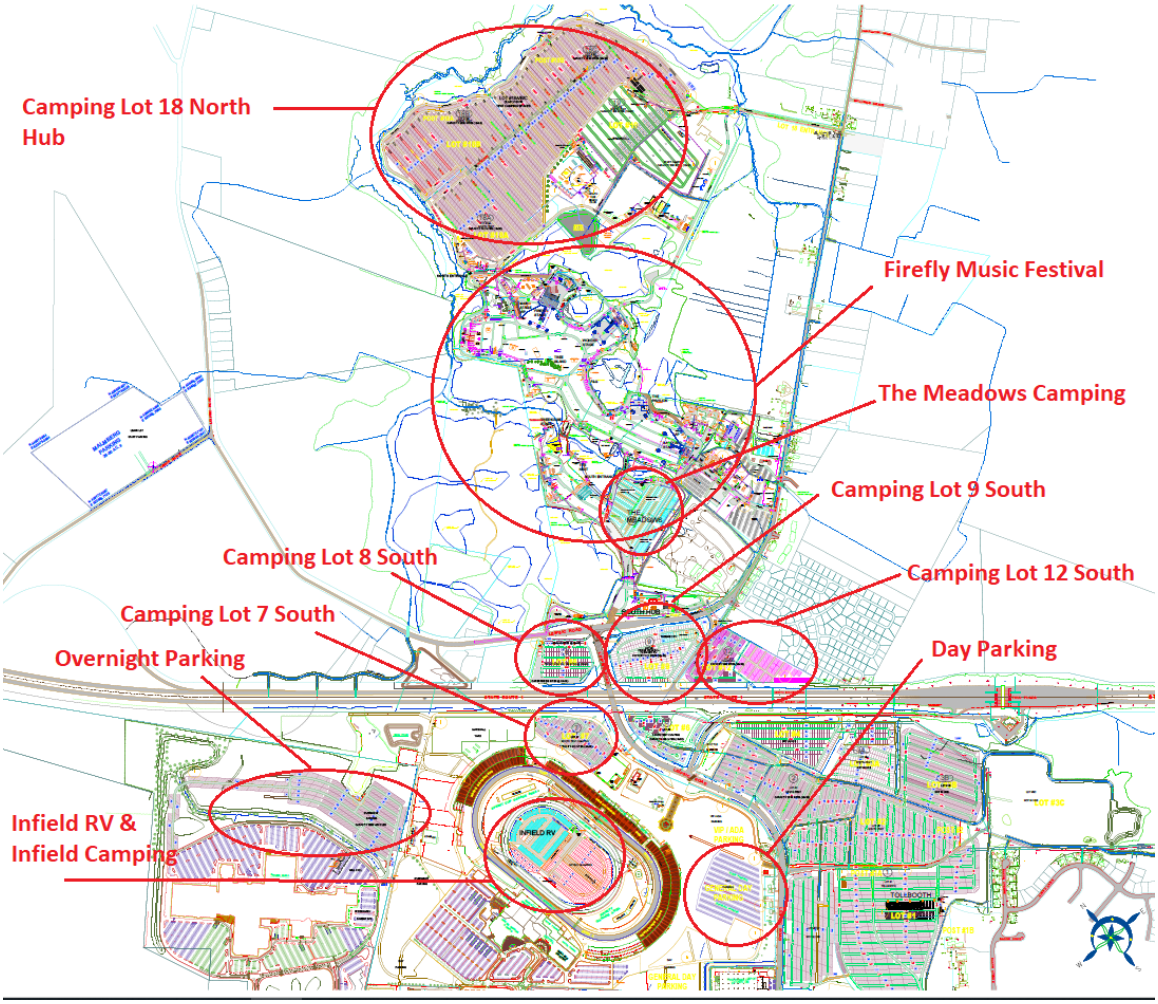
## Sample

AEG Presents and Dover Motor Speedway staff indicated on average, the target population is 50,000 attendees. This number remains consistent since year three of the festival; between 2015-2019, 2021. Of the population within Group A, 380 participants or 0.76% will be accepted as a sample population. While hotel, Airbnb/Vrbo attendance is missing from the data set, camping passes can be calculated based on purchase agreements, data is then aggregated to determine activation through the festival staff. While AEG Presents and DMS staff conservatively estimates 2.5 persons per vehicle, the exact number of attendees on camping lots cannot be accurately determined due to overnight parking numbers, and the fluidity with which attendees migrate throughout the multi day event, and single day passes being sold.

To assess the spatial distribution of festival attendees throughout the multi-day event, this study examined the camping lots in 2021 and their geographical proximity to the festival site, as depicted in Figure 5.

**Figure 5**

Geographical Map of Firefly 2021




Figures 6-14 visually depict lot layouts and designs with actual festival attendees, in approved State of Delaware Fire Marshal load in configurations. Lot 7 reported 100 cars; lot 8, reported 230 cars; lot 9, (which was an RV lot), reported 271; lot 10 reported 300 cars; lot 12 reported 560 cars; and lot 18 reported 6,500 cars. Infield camping reported a total of 400 cars.

**Figure 6**

Lot 7 Camping Firefly Music Festival

**Figure 7**

Lot 8 RV Lot

**Figure 8**

Lot 9 RV Lot

**Figure 9**

Lot 12 Camping Firefly Music Festival

**Figure 10**

The Meadows Campground

**Figure 11**

Lot 18 Camping Firefly Music Festival

**Figure 12**

Infield Camping Firefly Music Festival

**Figure 13**

Infield Camping/ Infield RV

**Figure 14**

General Day Parking (No Camping)

Given this information, and the conservative estimate of 2.5 person(s) per vehicle, the camping lots in total, held approximately 20,500 of the total attendees or 41.3% of the total guests. The author purposefully raised the concern regarding camping demographics in Chapter 2, given the unequal distribution of keys per vehicle and what may be perceived as safety through evacuation, albeit situationally dependent on the circumstances preceding evacuation. While 2.5 persons may arrive together, sharing the same method of travel, only one person is presumed to have unrestricted access to the vehicle if it is to be used as a shelter system, or as a means of escape/egress, potentially leaving some members of the social group behind. Intuitively, this may also become an issue for the distance and terrain that may be expected of festival attendees to evacuate with when privately owned vehicles may not be accessible.

A priori power analysis was conducted to determine the required minimum sample size for the quantitative analysis part of this study. Four factors were considered in the power analysis: significance level, effect size, the power of the test, and statistical technique. The significance level, also known as Type I error, refers to the chance of rejecting a null hypothesis given that it is true (Haas, 2012). Most quantitative studies make use of a 95% confidenece level because it adequately provides enough statistical evidence of a test (Creswell & Poth, 2017). The effect size refers to the estimated measurement of the relationship between the variables being considered (Cohen, 1988). Cohen (1988) categorizes effect size into small, medium, and large. Berger, Bayarri, and Pericchi (2013) purported that a medium effect size is better as it strikes a balance between being too strict (small) and too lenient (large). In most quantitative studies, an 80% power is usually used (Sullivan, & Feinn, 2012). The statistical test to be used for this study is structural equation modeling (SEM). Structural equation modeling is a multivariate statistical technique for analyzing structural relationships. It examines linear causal relationships between variables while accounting for measurement error, similar to but more powerful than regression analysis.

Due in part to the lack of guidelines for researchers to follow when conducting power analyses within the SEM framework, the power analysis of SEM is frequently disregarded in application research. Due to this, rule of thumb techniques have been used when estimating sample size for SEM. Wang and Rhemtulla (2021) recommend using using a rule of thumb that states the minimum sample size is between 100 and 200. Thus, this study aims to sample at least 100 participants.

Group B sample population will comprise a much smaller respondent pool, given the expertise and diversity of the FEMA Science and Technology Division. This dissertation will seek feedback from 8-12 subject matter experts on the feasibility of modifying the existing app while also looking at the current privacy terms and conditions to see if such changes would be major/minor to the existing rules as written.

## Ethical Issues

This study did not involve any physical experimentation, though passive observations were used during the festival. This research was referred to the St John's University Institutional Review Board (IRB) and approved, prior to data collection. IRB protects human subjects by ensuring research studies are compliant with laws regarding human participants. The surveys for Group A (festival attendees) and Group B (FEMA HQ) were administered online. All participants were provided written consent (through the survey) that they agreed to participate in the study voluntarily and could withdraw without penalty at any time. In addition, participants remained anonymous. The author ensured that no personal identifiable information was included in any of the notes or transcripts.

## Measurements

Research question #1 will utilize snowball sampling methods and Survey Monkey to delve into the festival attendee perspective to determine whether previous Firefly attendees trust the festival's authorities enough to follow evacuation directives intrinsically without being afforded the time to ascertain the status of missing/separated group members. Survey recipients will be asked to rank the importance of reunification with their social group against competing factors occurring during an evacuation.

Comparing the salience of social group reunification counter to other simultaneous options provides a deeper context of its level of importance than a Likert scale would be able to detail. A prioritized list of imperative actions to take during an evacuation will most accurately frame the importance reunification has to individuals in a social group and if reunification happens organically without intervention from an established reunification center directed by an incident commander.

Research question #2 will utilize snowball sampling methods and Survey Monkey to determine if OMF attendees would be willing to trade some measure of privacy to track their social groups' location throughout the festival. Specific hypothetical examples are proffered to respondents to illustrate what changes to expect regarding the existing Firefly Music Festival App. Open-ended questions enable participants to provide responses in their own words in order to gain a richer, more contextualized understanding of the phenomena than quantitative data alone can provide. Additionally, the survey will explore app familiarity to determine within the sample population the percentage of participants that utilize the Firefly Music App and if the app was downloaded prior to arrival or if respondents downloaded it while at the festival. Such questions are important as they will illustrate the familiarity with both the app itself and the promotion of said application.

Research question #3 will utilize purposive sampling (non-probability) using Survey Monkey as the only data collection tool to survey FEMA Headquarters (HQ) subject matter experts regarding the Firefly Music Festival app. FEMA HQ was provided with a revised 2022 AEG Presents Privacy Policy, directions for how to download the Firefly Music Festival app for Android and iOS platforms, and a link to the survey itself

(Group B Optimization of Reunification Capabilities at Outdoor Music Festivals: Empowering Social Groups to Maintain Situational Awareness Through Geofencing and Geolocation). This research will explore the feasibility of software app modifications that ultimately are intended to augment negative trust issues within social groups to ensure that verbal/visual communication modalities simultaneously facilitate the evacuation and reunification efforts. The research question will aim to understand to what extent can the current Firefly mobile app technology be modified to serve the function of situational awareness using geofencing and geolocation for OMF attendees. Specifically, can a three-mile radius be included surrounding the festival layout? Can a geofence be established around the 3-mile radius? Can geolocation be included within the app for festival attendees to monitor the social groups' location? Can a free text function be added within the app for use within the social group? Can the app include campsite layouts as a selection tool that will show the lane identifier within the campsite? Can a "pin" function be added to the software app to identify a location or meet-up space for social groups?

## Qualitative Data Analysis

Participants will enter the data from the qualitative component of the Group A survey into open-ended fields. SurveyMonkey software will record and compile participants' responses verbatim and export them in a Microsoft Excel spreadsheet. The Excel sheet will be imported as a survey-type source file into NVivo 12 qualitative data analysis software, which is used to increase the dependability and confirmability of qualitative analyses by maintaining a clear record of the decisions the researcher makes during the analysis process (Merriam & Tisdell, 2016).

The qualitative data will be analyzed using the inductive, thematic procedure recommended by Terry et al. (2017). The inductive nature of the procedure means that responses will be grouped into emergent categories with other responses that have similar meanings, rather than sorted into predefined categories. The thematic nature of the procedure means that the high-level findings identified through the analysis will be themes, or propositions, that summarize the meaning of the data from all or most participants in a phrase that addresses the research question. The findings will then be described in more detail with a narrative discussion of each emergent theme, including direct quotes from the data as evidence for the findings to enable the reader to assess the integrity of the analysis independently. A tabular presentation will also be included to indicate theme and code frequencies.

The inductive, thematic procedure recommended by Terry et al. (2017) has six steps. The steps are: (1) gaining familiarity with the data by reading and rereading it, (2) coding the data by grouping statements with similar meanings and labeling the groups descriptively, (3) searching for themes in the data by grouping related codes, (4)

reviewing the themes by comparing them to the original data to verify their accuracy, (5) naming and defining the themes, and (6) presenting the findings (Terry et al., 2017). The qualitative findings are presented in Chapter 4, along with the quantitative findings.

## Quantitative Data Analysis

Analysis of the resulting quantitative data will be conducted using the statistical software suite Statistical Package for the Social Sciences (SPSS) AMOS version 23. The data will be cleaned by examining the dataset for missing data (Field, 2018). If a value is missing, the entire case will be removed from the analysis (listwise deletion). In listwise deletion, a case is dropped from an analysis because it has a missing value in at least one specified variable. The analysis is only run-on cases that have a complete set of data. Categorical variables (i.e., nominal variables) will be dummy-coded for the purpose of regression (Field, 2018). Descriptive statistics of the data for the predictor and dependent variables will be reported. Frequency and percentages summaries will be obtained for categorical variables while the measure of central tendencies of means and standard deviations and minimum and maximum values will be conducted for continuous demographic variables, such as age.

Structural equation modeling (SEM) is conducted with SPSS AMOS to address the research questions. SEM is a set of statistical techniques used to measure and analyze the relationships of observed and latent variables. Similar but more powerful than regression analyses, it examines linear causal relationships among variables. The advantage SEM has over traditional multiple regression is that the significance of the relationships between the independent and dependent variables can be measured simultaneously instead of conducting separate multiple regressions. Figure 2 consists of

two independent variables (SI and SSA) and four dependent variables (PU, PEOU, AU, and ATU).

The data file must be first linked to AMOS. Next, the model, in Figure 3, is created in AMOS and the pertinent variables moved to each "rectangle." Next, the author will add arrows between the variables denoted in the figure in AMOS. These arrows depict the paths of the relationships. Once the model is created, the user specifies which options/methods are to be used in the analysis. For estimation, Maximum Likelihood is commonly used (Field, 2018). The validity of the structural model will be assessed by examining model fit indexes (Field, 2018). Criteria for overall good fit of a model were an RMSEA close to or below 0.08 and CFI and TLI greater than .90. Additionally, the p-values for each predictor may be examined in order to determine if it is significant. The predicator is significant if the p-value is less than or equal to .05.

Before conducting SEM, the testing of parametric assumptions must first be accomplished. Parametric assumptions are statistical tests conducted to determine when normality or homogeneity of variance assumptions are met or satisfied (Field, 2018). Field (2018) put forward the notion that multiple regression analysis includes linearity, normality, homoscedasticity, and multicollinearity. These assumptions for multiple regression are identical to SEM. Plots of the standardized residuals and the standardized predicted values are examined to assess linearity and homoscedasticity. If the plots are not curvilinear, there are no violations of the assumption of linearity (Field, 2018). Additionally, if the plots form a rectangular pattern, there is no violation of the assumption of homoscedasticity. A Shapiro-Wilk test of normality will be used to determine if the data are normally distributed. Kurtosis and skewness statistics will be

generated to further assess normality (Field, 2018). Finally, the variable inflation factor (VIF) will be calculated for each variable to determine if multicollinearity is violated between any two variables. If the VIF falls below 10, there is no violation of the assumption of multicollinearity. The author will assess outlier detection through visual inspection of the boxplots.

## Limitations of Research Design

The primary limitation of this research is the phenomenological study relied on one single event type multi-day OMF (Firefly Music Festival), located in Dover, Delaware, as a foundational assessment of human behavior in relation to technology acceptance modeling while simultaneously excluding other notable East Coast Music Festivals. A comparison study of East Coast OMFs that meet the research criteria would further validate the findings contained within this study, though one could posit that a more conclusive examination of AEG Presents owned/operated festivals will likewise bring about similar results.

The non-probability, purposeful sampling method utilized in this study prevented the results from being generalizable from the sample to the target population (Palinkas et al., 2015). Demographic information was collected and reported to the extent compatible with confidentiality to enable the reader to assess the transferability of the findings to other samples and settings on case-by-case basis, as recommended by Denzin and Lincoln (2008). Findings from the qualitative component of the study, which included the open-ended questionnaire items, were most credible with respect to the sample from which they were drawn, and transferability will depend on a comparison of the sample profile with the profiles of other samples in which the reader may be interested.

This research did not explore a subset of the population classified as access or functional needs. Such parameters are beyond the scope of this dissertation. With that in mind, Elize (2022) provided a comprehensive examination in relation to vulnerable group members and group leaders' decision making for outdoor venues, special events, and the subsequent effect on evacuation times as they relate to safe zones. The work is comprehensive, though it lacks the reunification component, instead opting for unspecified reunification abilities. Balata (2018) provided an extensive argument tying technology to the user experience, which facilitated the movement of person(s) safely from their starting location to their intended destination. The author stipulated within this dissertation that person(s) moving from point A to point B may be impaired visually. While I related this to excessive drinking or even injury, I failed to consider that the OMF will also have a subset of festival attendees with limited mobility and visual impairments that compromise their natural ability to exit safely, which may hamper/delay reunification efforts. Any mobile app modifications must also account for the limited visibility/mobility community.

Downloading the app remains voluntary at the time of this research. Festival attendees can accept or reject the idea of an aided festival experience. This means the app will not cover 100% of the festival attendee population and there will still be outliers regarding the modified mobile applications effectiveness.

Finally, this author acknowledges that RFID technology is already in-use by Firefly Music Festival and other notable OMF venues. While the geofencing and geolocation software would operate outside the RFID system, using a Wi-Fi signal, the identification of individuals may be hampered by conflicting data, i.e., RFID data versus

crowd-sensed data. This research does not account for how often festival attendees may attempt to circumvent the system of legitimate purchases and transfer the RFID-encoded bracelet that grants access to and from the festival to other individuals. Such research was thought to be beyond the scope of this study.

# CHAPTER 4: DATA ANALYSIS AND RESULTS

The purpose of this research is to apply Social Identity Theory concepts to a modified Technology Acceptance Model for existing application-based software technologies on Android and iOS platforms to facilitate user expectations of reunification efforts for pre-planned or spontaneous evacuations of Outdoor Music Festivals (OMF). By applying a modified TAM, the research investigated the relationship between perceived usefulness (PU) and the attitude toward use (ATU) of hypothetical crowd-connected software for situational/spatial awareness and reunification efforts of social groups that interface through Android and iOS platforms.

The following is a discussion of the study's population as well as a demographic description of the sample. Demographic descriptions included frequencies and percentages for categorical (nominal) variables and means and standard deviations measured at the interval level of measurement. Also presented are the testing of parametric assumptions for the statistical analysis and the results of statistical testing. This chapter concludes with a discussion of the results of this study.

## Research Questions and Hypothesis Acceptance

This dissertation seeks to address three research questions, and three research hypotheses. Conclusions regarding the three research questions will be discussed in Chapter 5; data analysis that supported acceptance or declination of the hypothesis will be presented throughout this chapter.

$R_1$. What is the overall level of Perceived Usefulness, Situational Spatial Awareness, Social Influence, Attitude towards Use, Actual Use, and Perceived Ease of Use for existing application-based software technologies on Android and iOS platforms

to facilitate user expectations of reunification efforts for pre-planned or spontaneous evacuations of Outdoor Music Festivals (OMF)?

$R_2$. What is the relationship between perceived usefulness (PU) and the attitude toward use (ATU) of hypothetical crowd-connected software for situational/spatial awareness and reunification efforts for social groups that interface through Android and iOS platforms?

$H_0$. There is no significant relationship between perceived usefulness (PU) and the attitude toward use (ATU) of hypothetical crowd-connected software for situational/spatial awareness and reunification efforts for social groups that interface through Android and iOS platforms.

$H_1$. A significant relationship exists between perceived usefulness (PU) and the attitude toward use (ATU) of hypothetical crowd-connected software for situational/spatial awareness and reunification efforts for social groups that interface through Android and iOS platforms.

$R_3$: To what extent can the current Firefly mobile app technology be modified to serve the function of situational awareness using geofencing and geolocation for OMF attendees?

$H_2$: The technology can be modified for AU, but users see no increase in PU.

$H_3$: The technology cannot be modified for AU.

## Data Collection – Summary and Execution

Using Firefly Music Festival, located in Dover, Delaware, the research examined a multiday OMF with an on-site camping component and a daily maximum capacity of 50,000 attendees to garner input for respondent data and considered the age demographics of those who attended in order to succinctly capture the sample population. A survey hosted on Survey Monkey collected demographic data as well as participants' willingness to relinquish or trade privacy concerns for perceived safety in the event of evacuation from an OMF. The survey measured items that corresponded to Perceived Usefulness (PU), Perceived Ease of Use (PEOU), increased safety Actual Use (AU), Situational Spatial Awareness (SSA), Social Influence (SI), and Attitude Towards Use (ATU) of the TAM.

In the sample, there were a total of $N = 380$ participants, comprising 150 (39.4%) males, 224 (58.9%) females, and 5 (1.3%) identifying as non-binary. The majority of respondents reported being married -133 participants, (35.0%),- followed by 122 participants (32.1%) indicating that they were single or had never been married. Refer to Tables 8, 9, and 10 below, for detailed demographic information.

**Table 8**

Gender

| | Frequency | Percent |
|---|---|---|
| Man | 150 | 39.5 |
| Non-binary | 5 | 1.3 |
| Woman | 224 | 58.9 |
| Prefer to self-describe, below | 1 | .3 |
| Total | 380 | 100.0 |

**Table 9**

Age

| | Frequency | Percent |
|---|---|---|
| 18-24 | 70 | 18.4 |
| 25-34 | 109 | 28.7 |
| 35-44 | 118 | 31.1 |
| 45-54 | 48 | 12.6 |
| 55-64 | 24 | 6.3 |
| 65+ | 11 | 2.9 |
| Total | 380 | 100.0 |

**Table 10**

Relationship Status

| | Frequency | Percent |
|---|---|---|
| Married | 133 | 35.0 |
| Widowed | 5 | 1.3 |
| Divorced | 43 | 11.3 |
| Separated | 6 | 1.6 |
| Cohabiting with a significant other or in a domestic partnership | 66 | 17.4 |
| Single, never married | 122 | 32.1 |
| Prefer not to answer | 5 | 1.3 |
| Total | 380 | 100.0 |

In order to measure the study variables of PU, PEOU, AU, SSA, SI, and ATU, the survey asked the questions depicted in Table F1 (Appendix F). The responses to the survey items were measured on a nominal scale, thus, the analysis of the study comprised of conducting descriptive statistics of frequencies and percentages as well as Chi-square tests to assess the relationships between PU and ATU. Chi-square tests measure associations between two nominal variables and were appropriate for this analysis (Field, 2018). What follows now are the results of the analysis conducted for the study.

## Data Analysis and Measurement

Descriptive analysis was conducted in order to address the first research question, whereas Chi-square analysis as well as SEM was conducted to address the second research question. Descriptive statistics included frequencies and percentages of the survey item responses. Thirteen items measured PU; fifteen items measured SSA; fifteen items measured SI; three items measured ATU; two items measured AU; and one item that measured PEOU. Inferential analysis was conducted by Chi-square analysis and SEM with SPSS.

## Results and Hypotheses Tests

The results of descriptive and inferential analysis now follow. Descriptive statistics will include the frequency and percentages of responses of each survey item. This will then be followed by the results of Chi-square tests to measure associations. Descriptive statistics were conducted in order to address this first research question:

*R1. What is the overall level of Perceived Usefulness, Situational Spatial Awareness, Social Influence, Attitude towards Use, Actual Use, and Perceived Ease of Use for existing application-based software technologies on Android and iOS platforms to facilitate user expectations of reunification efforts for pre-planned or spontaneous evacuations of Outdoor Music Festivals (OMF)?*

## Descriptive Statistics Results

### Perceived Usefulness Responses:

Thirteen items measured Perceived Usefulness. The frequencies and percentages of each item's response are presented in Table F2 (Appendix F). The items with the greatest frequencies were "If the Firefly Music Festival App was able to show key areas

(such as medical tents, relocation centers, lost and found locations, or cell phone charging stations) in relation to your location, would you be more likely to use the app?" with 88.7% stating "yes", which was followed by "Did you travel/arrive with friends to Firefly Music Festival?", with 79.7% stating "yes". More responses are provided in Table F2 in Appendix F.

**Situational Spatial Awareness Responses**:

Fifteen items measured Situational Spatial Awareness. The frequencies and percentages of each item response are presented in Table F3 (Appendix F). The items with the greatest frequencies were "When you attended Firefly Music Festival, did you know where the relocation center was located in the event of a planned or unplanned evacuation?" with 77.9% stating no. This was followed by "Do you trust authority's instructions enough to listen/follow without making contact with your friends/group during an evacuation prior to reunification?" with 65.5% stating "yes". Additional responses are provided in Table F4 in Appendix F.

**Social Influence Responses:**

Fifteen items measured Social Influence. The frequencies and percentages of each item's response are presented in Table F4 (Appendix F). The items with the greatest frequencies were "Look for festival security/law enforcement to protect me" with 72.4% stating unlikely, and "I would focus on packing up my belongings and leaving" with 65.5% stating very unlikely. More responses are provided in Table F4 in Appendix F.

**Attitude towards Use Responses:**

Three items measured Attitude towards Use. The frequencies and percentages of each item's response are presented in Table F5 (Appendix F). The item with the greatest frequency was "Would you be willing to allow the Firefly Music Festival App to access the same data as Facebook, Instagram, Snapchat, WhatsApp, and/or Twitter, if it aided in your perception of increased safety or security for yourself and your group?" with 51.3% stating "yes". These findings are particularly important as they contradict the earlier work proposed by Blanke, et al. (2014), which stated that festival attendees viewed safety as an abstract concept regarding the Swiss-based mobile application. This was followed by "Would you be willing to allow the Firefly Music Festival app to access the same data that apps such as Facebook, Instagram, Snapchat, WhatsApp, and/or Twitter do, if you found value in the app?" with 38.7% stating "yes", and finally 33.7% stated that they were somewhat interested in the ability to join additional social groups via the Firefly Music Festival App to track new friends' locations during the festival. See Table F5 in Appendix F.

**Actual Use Responses:**

Two items measured Actual Use. Forty-four percent stated that they did not read the Privacy Terms and Conditions before downloading the Firefly app. Additionally, 50.8% stated that they downloaded the app before arriving at the festival. This dataset is represented in Table 11.

**Table 11**

Actual Use

| Item | *f* | % |
|---|---|---|
| Before downloading the Firefly Music Festival app, did you read the Privacy Terms and Conditions? | | |
| Yes | 94 | 24.7 |
| No | 169 | 44.5 |
| I did not download the app | 117 | 30.8 |
| When did you download the Firefly Music Festival app? Choose the answer that best describes your experience. | | |
| I did not download/use the app | 139 | 36.6 |
| Before arriving at the festival | 193 | 50.8 |
| When I arrived to the festival | 37 | 9.7 |
| During the festival | 11 | 2.9 |

**Perceived Ease of Use Responses:**

There was one item that measured Perceived Ease of Use which asked, "Did you personally utilize the Firefly Music Festival Mobile App during the festival?", where 57.1% stated "yes" and 42.9% stated "no". Accounting for the app-based culture of modernity and the fact that a mobile app currently exists for Firefly Music Festival, PEOU is (numerically) either accepted or rejected regardless of modification. See Table 12.

**Table 12**

Perceived Ease of Use

| | *f* | % |
|---|---|---|
| Yes | 217 | 57.1 |
| No | 163 | 42.9 |
| Total | 380 | 100.0 |

## Results of Hypothesis Testing

The combined use of Chi-square tests and SEM facilitated a multifaceted exploration of the second research question and hypothesis, providing a comprehensive and nuanced perspective that extends beyond mere statistical confirmation. This methodological synergy allowed for a more profound analysis, enabling a thorough examination of the intricate factors and relationships relevant to the study's objectives.

*R2. What is the relationship between perceived usefulness (PU) and the attitude toward use (ATU) of hypothetical crowd-connected software for situational/spatial awareness and reunification efforts for social groups that interface through Android and iOS platforms.*

*H0. There is no significant relationship between perceived usefulness (PU) and the attitude toward use (ATU) of hypothetical crowd-connected software for situational/spatial awareness and reunification efforts for social groups that interface through Android and iOS platforms.*

*H1. There is a significant relationship between perceived usefulness (PU) and the attitude toward use (ATU) of hypothetical crowd-connected software for situational/spatial awareness and reunification efforts for social groups that interface through Android and iOS platforms.*

## Results of Chi-Square Tests

Chi-square tests were conducted to examine the relationship between PU and ATU. Specifically, the responses to the ATU item “Interest in the ability to join additional social groups via the Firefly Music Festival App to track new friends' locations during the festival” was compared to the responses of all 13 perceived use items. The

results are depicted in Table F6 (Appendix F). ATU was significantly associated with the following items: “Would you be more likely to utilize the app if you could view/follow your friends' current location within the festival?”; “Would you be more likely to utilize the app if you could view/follow your friends' location within the festival campground?”; “If the modified Firefly Music Festival App provided a ‘pin location’ to mark your campsite or areas of interest, how likely would you be to use the app?”; “If the Firefly Music Festival App was able to show key areas (such as medical tents, relocation centers, lost and found locations, or cell phone charging stations) in relation to your location, would you be more likely to use the app?”; “If the Firefly Music Festival App provided you with pre-staged ridesharing/bus locations in relation to your location, would you be more likely to use the app?”; “Would you be more likely to use the Firefly Music Festival App if you could interact with your friends through it with a text/messaging function?”; and “While at Firefly Music Festival, your friend calls you worried about their safety. You can see their location through the Firefly Music Festival App. Would you find it beneficial if the app also had a function where you could relay this information to security: Knowledge of the situation (authority providing details), Seriousness of the situation during the OMF, Influence of other attendees (witnessed actions/communications), Having accessible information (technology)”.

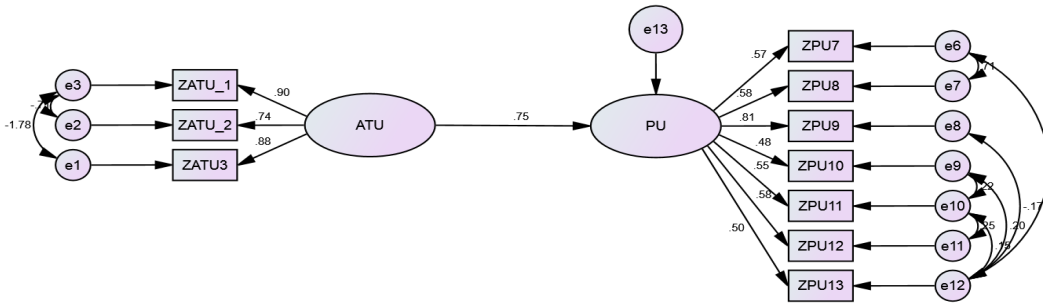
Therefore, the null hypothesis is rejected, and it is concluded that there is a significant relationship between PU and the ATU of hypothetical crowd-connected software for SSA and reunification efforts for social groups that interface through Android and iOS platforms.

## Structural Equation Modeling (SEM)

SEM was conducted with SPSS AMOS to assess the relationship between ATU and PU. Three items that measured ATU were standardized, and nine standardized items of PU were used in the model as depicted in Figure 15.

**Figure 15**

SEM Model of ATU Predicting PU




The fit indices used to assess the validity of the model were CMIN ($\chi 2$/df), CFI, TLI, and RMSEA. According to Field (2018), acceptable values for these fit indices are CMIN < 5.0, CFI > 0.90, TLI > 0.90, RMSEA < 0.08. The model showed good fit with CMIN = 2.118, CFI = .973, TLI = .951, and RMSEA = .066. There was a significant positive association between ATU and PU ($B$ = 0.484, $SE$ = 0.056, $p$ < .001). See Table 13. Thus, the null hypothesis is again, rejected, and it is concluded that there is a significant relationship between PU and the ATU of hypothetical crowd-connected software for SSA and reunification efforts for social groups that interface through Android and iOS platforms.

**Table 13**

Regression Weights for ATU Predicting PU

| | | | *B* | *S.E.* | *p* |
|---|---|---|---|---|---|
| PU | <--- | ATU | .484 | .056 | <.001 |
| ZATU3 | <--- | ATU | 1.000 | | |
| ZATU_2 | <--- | ATU | .840 | .069 | <.001 |
| ZATU_1 | <--- | ATU | 1.020 | .095 | <.001 |
| ZPU7 | <--- | PU | 1.000 | | |
| ZPU8 | <--- | PU | 1.017 | .062 | <.001 |
| ZPU9 | <--- | PU | 1.423 | .134 | <.001 |
| ZPU10 | <--- | PU | .845 | .111 | <.001 |
| ZPU11 | <--- | PU | .957 | .115 | <.001 |
| ZPU12 | <--- | PU | 1.017 | .116 | <.001 |
| ZPU13 | <--- | PU | .869 | .113 | <.001 |

A sample of 12 subject matter experts (SMEs) participated in a survey to assess AEG Presents usage of Firefly Music Festival's mobile app regarding the apps ability to be modified, as well as measuring perceptions of geofencing, geolocation, tracking capabilities, and privacy. There were a total 16 items in the survey that participants responded to. The first item on the survey was "Can the current Firefly Music Festival App design and configuration be modified?" where most participants stated, "a lot", 7 (58.3%). This was followed by "completely", 2 (16.7%); "a moderate amount", 2 (16.7%); and "not at all", 1 (8.3%).

The next item was "Could the Firefly Music Festival App be modified to include geofencing/geolocation updates of festival attendees' locations?". Most responses stated "yes", 11 (91.7%). Only one person stated "no". Regarding the survey question, "Would geofencing and/or geolocation additions alter the already established privacy policy settings for Firefly Music Festival Mobile App?", most people stated, "a little", 5

(41.7%). The next item was “Can mobile apps be modified to allow social groups to track each other’s location(s) and display said location(s) over a map feature?”, and all 12 participants stated “yes”. Additionally, all 12 participants responded “yes” to the item “Can mobile apps be modified in such a way that users could drop a pin on their location, accessible only by other users within the same social group?”.

The majority of participants responded “yes” to the item, “Can mobile apps be modified in such a way that would allow for pre-identified locations to be dormant or active as the situation dictates by the Command Team?” 11 (91.7%).

The next item asked was “Would location tracking alter the already-established privacy policy settings for Firefly Music Festival Mobile App users?” where most stated “a moderate amount”, 4 (33.3). This was followed by “a little”, 3 (25%).

All 12 participants responded “yes” to the item “Is it possible to allow users interfacing with a modified app to raise concerns (e.g., suspicious persons, unconscious individual, bus location, Uber/Lyft location, medical or EMS locations, etc.) directly to designated law enforcement/security personnel?”

Regarding the item, “How likely is it that the app can be modified so that individuals within social groups can share their location with multiple (other) social groups simultaneously?”, most people stated “likely”, 9 (75%).

The next item was “Could modifications to the existing Firefly Music Festival app support a text function between members within the social group?”. Most participants stated “yes”, 11 (91.7%). In response to the item, “Would location tracking alter the already-established privacy policy settings for Firefly Music Festival Mobile App users?”, most stated “a moderate amount”, 4 (33.3%).

All 12 participants answered yes to the item, “Is it possible to allow users interfacing with a modified app to raise concerns (e.g., suspicious persons, unconscious individual, bus location, Uber/Lyft location, medical or EMS locations, etc.) directly to designated law enforcement/security personnel?”

Nine (75%) participants stated that it was “likely” that “...the app can be modified so that individuals within social groups can share their location with multiple (other) social groups simultaneously”.

Eleven (91.7%) people responded “yes” to “Could modifications to the existing Firefly Music Festival app support a text function between members within the social group?”, whereas most people responded “a lot” to the item “Would the addition of a text function within the Firefly Music Festival App alter the established Privacy Policy settings for users?”, 5 (41.7%).

Nine (75.0%) people responded that it was “very valuable” that “From a Science and Technology perspective, geolocation/geofencing data for festival attendees be for the Incident Command team in providing a real-time operational picture? *Firefly Music Festival annually hosts 50,000 festival attendees”.

Regarding the item, “From a Science and Technology perspective, if an incident were to occur at an Outdoor Music Festival prompting an evacuation, could geolocation/geofencing software potentially aid first/emergency responders in locating lost or missing individuals?” 6 (50%) people responded, “a lot”.

Eight (66.7%) participants responded “strong value” to the item “With respect to Soft Targets/Crowded Places and situational awareness, do you see value in a social groups ability to have access to each other’s location where the possibility of a planned on unplanned evacuations exist?”

Six (50%) people responded “extremely helpful” to the item, “Post evacuation: If an Incident Commander decided to establish a reunification center for evacuees, would it be helpful to pin the location (within the modified app) for attendees that may not be familiar with the surrounding area outside the festival group?”.

Finally, 8 (66.7%) stated “neither likely nor unlikely” to the item, “If social groups were empowered through the hypothetical modifications to the existing Firefly Music Festival app, how likely is it that the potential capacity of expected person(s) requiring an official reunification center could be reduced?”. Table F7 in Appendix F provides detailed frequencies and percentages of these item responses.

**Helping Behaviors amongst Festival Attendees in Emergency Situations**

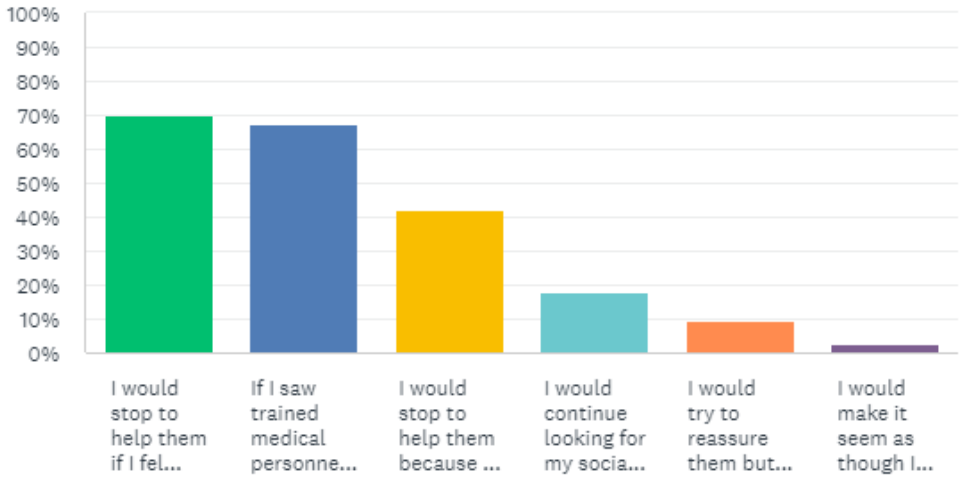
An ancillary aspect of this research, and by extension the two specific research questions contained within the administered survey, sought to validate the existence of “helping behaviors” or assimilations of individuals into existing social groups that may manifest during evacuation incidents at OMFs. As previously stated, there was a total of $N = 380$ participants in the sample which included 150 (39.4%) males and 224 (58.9%) females.

Question 16 asked participants, “While evacuating the festival, you witness individuals (who you do not know) that appear hurt/injured calling out for help. Check any of the following options that may reflect your response – (Please choose at least

one).” The option to select more than one answer was afforded to survey participants as the question is situationally dependent and could be construed as abstract. The majority of respondents, 268 (69.61%), stated “They would stop and help the injured if they felt it was safe.” Additionally, 163 (42.34%) responded that they “Would stop to help them because they would feel compelled to do so.” Conversely, the data also affirmed 69 participants (17.92%) “Would continue looking for their social group/friends as they were the priority.” Only 11 (2.86%) responded, “I would make it seem as though I did not see or hear them.” Figure 16 provides detailed percentages of these item responses.

**Figure 16**

Helping Behavior Actions

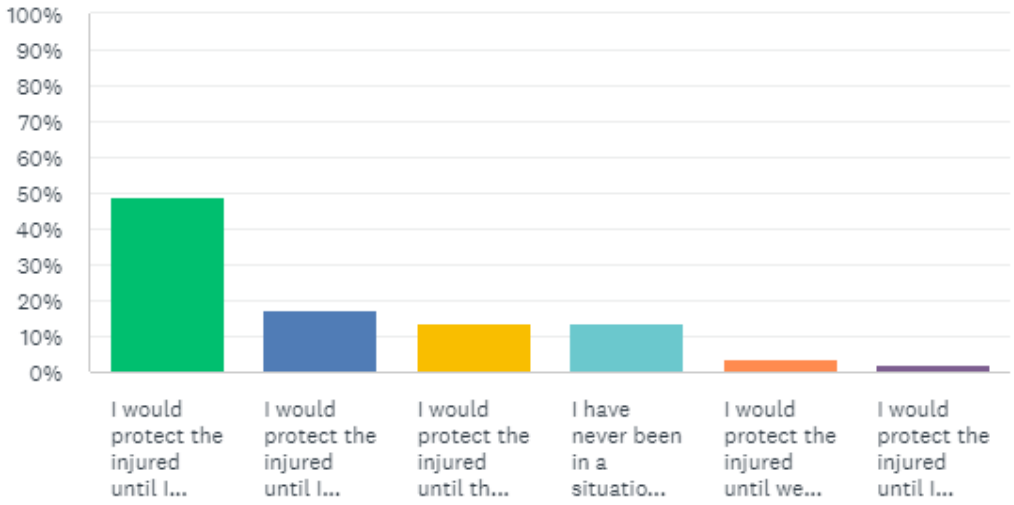



Question 17 explored the perceived responsibility of helping behaviors by those rendering aid to victims. The question asked: “How long would you feel responsible to render care for an injured person(s)? Select one answer from the list below.” The majority of participants, 189 (49.09%), responded “I would protect the injured until I found law enforcement or medical assistance.” Fifty-two (13.51%) designated “I have

never been in a situation like this, and I don't know how I'd react." Assuming the relocation center was known, accessible, and available, 15 (3.90%) respondents selected, "I would protect the injured until we arrived at an established reunification center." Figure 17 provides detailed percentages of these item responses.

**Figure 17**

Helping Behavior Responsibility




## Summary

The purpose of this research is to apply Social Identity Theory concepts to a modified Technology Acceptance Model for existing application-based software technologies on Android and iOS platforms in an effort to facilitate user expectations of reunification efforts for pre-planned or spontaneous evacuations of Outdoor Music Festivals (OMF). Thirteen items measured PU. The items with the greatest frequencies were: "If the Firefly Music Festival App was able to show key areas (such as medical tents, relocation centers, lost and found locations, or cell phone charging stations) in relation to your location, would you be more likely to use the app?", with 88.7% stating

"yes", and "Did you travel/arrive with friends to Firefly Music Festival?", with 79.7% stating "yes".

Fifteen items measured SSA. The items with the greatest frequencies were: "When you attended Firefly Music Festival, did you know where the relocation center was located in the event of a planned or unplanned evacuation?" with 77.9% stating "no", and "Do you trust authority's instructions enough to listen/follow without making contact with your friends/group during an evacuation prior to reunification?" with 65.5% stating "yes".

Fifteen items measured SI. The items with the greatest frequencies were: "Look for festival security/law enforcement to protect me" with 72.4% stating unlikely, and "I would focus on packing up my belongings and leaving" with 65.5% stating very unlikely.

Three items measured ATU. The item with the greatest frequency was, "Would you be willing to allow the Firefly Music Festival App to access the same data as Facebook, Instagram, Snapchat, WhatsApp, and/or Twitter, if it aided in your perception of increased safety or security for yourself and your group?", with 51.3% stating "yes". This was followed by, "Would you be willing to allow the Firefly Music Festival app to access the same data that apps such as Facebook, Instagram, Snapchat, WhatsApp, and/or Twitter do, if you found value in the app?", with 38.7% stating "yes". See Table 15.

Two items measured AU. Forty-four percent stated that they did not read the Privacy Terms and Conditions before downloading the Firefly app. Additionally, 50.8% stated that they downloaded the app before arriving at the festival. There was one item that measured PEOU which asked, "Did you personally utilize the Firefly Music Festival Mobile App during the festival?", where 57.1% stated "yes" and 42.9% stated "no".

Additionally, Chi-square tests revealed that there were statistically significant associations between PU and ATU items. The results of the Chi-square tests were provided in Table 18. Additionally, results of SEM indicated that there was a significant positive association between ATU and PU ($B = 0.484$, $SE = 0.056$, $p < .001$).

Additionally, a sample of 12 SMEs participated in a survey in order to assess AEG Presents' usage of Firefly Music Festival's mobile app regarding the app's ability to be modified, as well as measuring perceptions of geofencing, geolocation, tracking capabilities, and privacy. The responses to 16 survey items were presented in Table 19 previously. Results of descriptive statistics revealed that the overall consensus was that the current Firefly mobile app technology could be modified to serve the function of situational/spatial awareness using geofencing and geolocation for OMF attendees as well as serve as a tool for incident commanders to make informed decisions with coordinating partners and other response agencies. Given this function, it is theoretically possible to display the geolocation data of all participating festival attendees within a command center or forward operating location.

What follows in Chapter 5 is a discussion as to how the results of this study are interpreted in the context of the theoretical framework. Any limitations of the results of the study will be provided. Additionally, recommendations for future research will be discussed.

# CHAPTER 5: DISCUSSION, RECOMMENDATION, AND CONCLUSION

This research has contributed to the ever-important and growing field of crowd behavior, evacuation, and reunification of social groups by applying Social Identity Theory (SIT) concepts into a modified Technology Acceptance Model (TAM) for existing application-based software technologies on Android and iOS platforms, particularly for Outdoor Music Festivals (OMF). The aim was to enhance user expectations of reunification efforts during both pre-planned and spontaneous evacuations. To investigate the dynamics of evacuations and their impact on reunification, the study employed snowball sampling through Survey Monkey for research questions one and two, examining the perspectives of Firefly Music Festival attendees. This exploration sought to understand whether attendees trust festival authorities enough to follow evacuation directives without prioritizing time to locate missing or separated group members. In contrast, research question three utilized purposive sampling (non-probability) with Survey Monkey as the sole data collection tool, targeting FEMA Headquarters (HQ) SME. This phase aimed to gather insights into the Firefly Music Festival app. Quantitative data resulting from these inquiries was analyzed using the Statistical Package for the Social Sciences (SPSS) AMOS version 23.

Thirteen items within the survey measured users' Perceived Usefulness (PU) of an updated Firefly Music Festival app, and the items with the most significant frequencies indicated that if the proposed app was able to show critical areas such as medical tents, relocation centers, lost and found locations, or cell phone charging stations concerning participants' location, participants would be more likely to use it. The findings demonstrate that the PU of the app contributes to its adoption and thus familiarization by

the participants. Fifteen items measured the importance of Situational Spatial Awareness (SSA) to the end user, and the ones with the most significant frequencies indicated negative responses regarding knowing where the relocation center was located in the event of a planned or unplanned evacuation, in which participants highlighted lacking knowledge of relocation areas when attending the Firefly Music Festival. However, some participants revealed that they trusted the authority's instructions enough to listen/follow without contacting their friends/group during an evacuation before reunification.

Fifteen items measured the bearing of Social Influence (SI), and the items with the most significant frequencies highlighted that participants were unlikely to look for festival security/law enforcement to protect them. At the same time, some would focus on packing up their belongings and leaving the festival.

Three items measured participant's Attitude Towards Use (ATU) of this proposed technology. The item with the most significant frequency demonstrated that participants were willing to allow the Firefly Music Festival App to access the same data as Facebook, Instagram, Snapchat, WhatsApp, and Twitter if it aided in their perception of increased safety or security for themselves and their group. Further, some participants stated that they were somewhat interested in the ability to join different social groups via the Firefly Music Festival App to track new friends' locations during the festival.

Two items measured Actual Use (AU). Some participants indicated that they did not read the Privacy Terms and Conditions before downloading the Firefly app, and most had downloaded it before arriving at the festival.

The one item that measured Perceived Ease of Use (PEOU), or how user-friendly the existing app appeared, indicated that participants personally utilized the Firefly Music

Festival Mobile App during the festival. The Chi-square tests revealed statistically significant associations between PU and ATU. Additionally, the results of SEM indicated that there was a significant positive association between PU and ATU ($B = 0.484$, $SE = 0.056$, $p < .001$). The ensuing section engages in a detailed discussion to clarify the interpretation of the study's outcomes within the framework of the theoretical underpinnings. The presentation of any constraints or limitations inherent in the study's results is carefully articulated, providing a comprehensive understanding of the research context. Furthermore, this section unveils the far-reaching implications derived from the study findings, shedding light on their significance and potential impact. In addition to revealing the present implications, the dissertation extends to the formulation of recommendations for prospective research endeavors, emphasizing areas that warrant further exploration and investigation.

## Discussion of Findings

Thirteen items measured perceived usefulness, and the items with the greatest frequencies indicated that the Firefly Music Festival App was able to show critical areas such as medical tents, relocation centers, lost and found locations, or cell phone charging stations concerning participants' location, who revealed that they would be more likely to use the app. The findings demonstrate that the perceived usefulness of the app contributes to its adoption by the participants.

Results confirm past research by Saadé and Bahli (2005), who urged that PU concerning TAM is a critical factor in determining if one decides to embrace the technology through AU. Talantis et al. (2020) again confirmed PU's influence over AU as relevant and scalable when determining participant acceptance of mobile application

technology concerning TAM. Norfolk and O'Regan, (2020) and Saadé and Bahli (2005) should be viewed collectively to avoid misconceptions regarding TAM between academia, practitioners, and the community they intend to serve. The convergence of findings in the current study and previous research by Norfolk & O'Regan, (2020) and Saadé & Bahli (2005) indicate that a mobile app's perceived usefulness directly affects its actual use by the users at the music festival.

When looking at web-based applications, which use the internet for possible information exchanges, such as Facebook, Instagram, or Snapchat, findings demonstrated that needs or social inclusion would outweigh the overarching concern of privacy. The PU of such apps will likely prompt the evacuees or attendees to embrace the applications (Cousineau et al., 2018). Consistent with current study findings, previous literature revealed that the current generation embodies an "apps culture," which can be shared as a social trait and passed on to future generations until such time when application-based software is commonplace across all demographics, and accessibility to information and leisure regarding the Internet-of-Things (IoT) may act as a catalyst in the use of technology (Brown et al., 2020; Van Winkle et al. , 2018).

Research findings demonstrated that the PU of an application contributes to its adoption by the users because it fulfills the perceived use and accomplishments of those intending to use them. In contrast to current study findings, past research indicates that because of significant growth in the IoT domain, accessibility of app-based information has moved beyond computers and phones and can now include smart watches or even intelligent cars (Belkhouja & Doppa, 2020). The divergent results between past research and current study findings likely stem from variations in the generational context of prior

investigations, during periods characterized by high perceived usefulness (PU) of such applications, compounded by significant technological advancements. For example, Cousineau et al. (2018) asserted that younger demographics including both males and females, especially millennials, exhibit a higher likelihood of sharing their data compared to baby boomers. This predisposition is attributed to the increased integration of technology in everyday life and millennials perceiving said technology as more useful in contrast to the limited technological advancements seen in the baby boomer generation. (Khalaf, 2015; Taraszow et al., 2010). The study results add to past literature by establishing that the PU of the app contributes to its adoption by the participants.

Fifteen items measured SSA, and the items with the most significant frequencies indicated negative responses regarding knowing where the relocation center was located in the event of a planned or unplanned evacuation, in which participants highlighted lacking knowledge of relocation areas when attending the Firefly Music Festival. However, some participants revealed that they trusted the authority's instructions enough to listen/follow without contacting their friends/group during an evacuation before reunification. Study results imply that some users prefer using technology for awareness of relocation areas, while others rely on authority's instructions without contacting friends or groups attending the Firefly Music Festival.

The findings have also been reported in other studies. Consistent with current study findings, Drury et al. (2013) and Oh, et al. (2010) contended that messaging or situational awareness, particularly from credible sources, allays anxiety, which may assist in long-term psychological recovery in incidents where safety and security are present. Considering Drury's assessment alongside the current study's findings, quantitative data

science, and the geo-referenced social media posts from Andreson et al. (2019), it becomes evident that pre-incident communication can effectively acquaint both intergroup and intragroup entities with potential responses to questions that may arise post-incident. This process is facilitated through the utilization of scalable data that sheds light on specific human behaviors, actions, or perceptions (Bica et al , 2020).

The results of our study suggest that Firefly Music Festival attendees' inclination to utilize mobile applications for group or individual relocation is significantly influenced by their experience with SSA. Furthermore, insights from additional studies emphasize the impact of festival-specific app features, designed to enhance the festival experience. These features are more likely to be shared among attendees, particularly within their social circles, playing a pivotal role in fostering communication and contributing to the organic spread of awareness during the event (Blanke et al. 2014). Research from previous studies underscores the complex scenario faced by festival attendees in determining evacuation routes and coordinating post-evacuation reunification. This challenge is compounded by a scarcity of viable alternatives for secondary accommodations, often exacerbated by the pre-booking of options like Airbnb, VRBO, hotels, and motels, coupled with a general lack of familiarity with the surroundings (Gibson & Connell, 2005; Plangpramool, 2013). This knowledge highlights the need for academia and practitioners to prepare for efficient pedestrian traffic flows while minimizing contra flows. The development of 'music tourism' can draw crowds from various geographical locations, adding complexity to evacuation planning (Amideo et al., 2019; Gibson & Connell, 2005; Plangpramool, 2013).

The significance of evacuation route selection should extend beyond logistics to include psychosocial considerations related to collective behaviors within social groups. This involves incorporating shelter and reunification sites for SSA, as well as understanding the use of mobile applications among Firefly Music Festival attendees (Aradau, 2015).

The study results have demonstrated social influence as a critical motivator for using technology among the Firefly Music Festival attendees. Fifteen items measured SI, and the items with the greatest frequencies highlighted that participants were unlikely to look for festival security/law enforcement to protect them. At the same time, some would focus on packing up their belongings and leaving the festival. The implication is that participants did not require social influence to decide on an event regarding their protection but decided to take measures such as leaving the festival.

In contrast to the present study's findings, previous research asserted that social influence holds significance within social systems and may even passively rely on conformity rather than individuality (Hsu & Lin, 2008). Similarly, Busselle and Bilandzic (2008) stipulated that public persuasion, that is, the effectiveness of individuals and groups, deals with what they deem as mental models. Each model targets different audiences in ways they might tend to be influenced. Divergence from the appropriate narrative or the appropriateness of said narratives will conflict with the mental models, thus adding or detracting from the individual's decision-making abilities and cognitive speed with which they delay or act on information (Busselle & Bilandzic, 2008).

Social influence (in both physical and virtual settings) among social groups creates awareness and enhances decision-making during an emergency in which

individuals can help each other take a particular action. Accounting for social group psychological factors of the decision-makers, such as hesitation risk and trust risk, are vital to understanding social influence and the reliability of LSGEDM ((Ding et al., 2021; Xu, 2020). Current study findings disagree with past research in demonstrating that participants were unlikely to seek festival security/law enforcement to protect them, while some would focus on packing up their belongings and leaving the festival.

In contrast to current study findings, past studies revealed that to emphasize the role of social influence and personal perceptions in help-seeking behaviors, one must first perceive that an incident is occurring outside the context of what is considered normal behavior, recognize/interpret the information, and compel action or inaction on the part of the individual or group (Bartlett, 1932; Fiske & Taylor, 1991; Gist & Lubin, 1999). Preexisting social cohorts, variables, broad social attachments, interactions with others, and previous similar experiences can influence these internal and external relationships, such as using technology to contact social groups for help in case of an issue (Chu et al. 2014; Mawson, 2005; Raphael, 2005). The differences in findings could be because of generational differences in technology adoption.

Regarding the (ATU), noteworthy findings indicate that participants exhibited a distinct inclination to grant the Firefly Music Festival App access to data comparable to that of Facebook, Instagram, Snapchat, WhatsApp, and Twitter. This disposition was contingent upon the belief that such data sharing contributed to an enhanced sense of safety and security for both the individuals themselves and what they considered as their social groups. It is pertinent to note, however, that the conclusions drawn from this study diverge from those presented by Blanke et al. (2014). The latter asserted that the safety

features of similar applications were overly abstract for users to comprehend, thereby negating any discernible benefit. Moreover, Blanke et al. (2014) emphasized that functionalities such as the friend finder were already available on mobile apps like "WhatsApp" and "Glimpse," leading to the perspective that the inclusion of such features within the Firefly Music Festival App may be perceived as redundant and, consequently, lacking practical significance. What may be deemed abstract or redundant in one context might be embraced or valued in another, depending on user needs and expectations. While friend finder functionalities may indeed exist in other applications like WhatsApp and Glimpse, the distinctiveness of the Firefly Music Festival App's implementation, user interface design, and the festival-specific context may offer unique advantages.

Moreover, the desire to optimize the festival experience, including the need to keep mobile phones charged throughout the event, adds another layer to the evaluation. The integration of multiple apps with similar functionalities can contribute to battery drainage, potentially affecting the overall usability and practicality for festival attendees. In this light, the consolidation of features within a single festival-specific app, such as the Firefly Music Festival App, may address concerns related to battery efficiency and streamline the user experience.

Certain participants expressed a degree of interest in the prospect of connecting with various social groups through the Firefly Music Festival App to monitor the locations of new acquaintances during the event. These outcomes present a departure from established research, underscoring a level of inconsistency in the universal accessibility of technological systems and its impact on attendees' attitudes towards technology at the Firefly Music Festival (Norfolk & O'Regan, 2020). Nevertheless, the

findings align with the perspectives of Saadé and Bahli (2005) as well as Norfolk and O'Regan (2020), suggesting that shifting focus from intention to attitudinal considerations may offer insights into positions regarding the availability of biometric technology. It is worth noting, however, that such an approach may not fully address challenges associated with respondents who may lack familiarity with the technology deployed at music festivals.

Some participants admitted to their abstention from reading the Privacy Terms and Conditions before downloading the Firefly app. Additionally, most admitted that they downloaded the app before arriving at the festival. The one item that measured Perceived Ease of Use indicated that participants personally utilized the Firefly Music Festival Mobile App during the festival. The findings agree with past literature that perceived Ease of Use as key to making individuals understand the degree to which a person believes that using a particular system would be free of effort (Davis (1989). Research findings reveal tangible utilization patterns of the Firefly Music Festival Mobile App during the festival. On the contrary, past research indicates that a group's image-related concerns are at the center of perception-based interactions and the shared social identity present in the members embracing actual use of the Firefly Music Festival Mobile App during the festival (Wakefield & Hopkins, 2017).

Results also revealed a statistically significant relationship between PU and ATU items. Further, a significant positive association was found between ATU and PU. The implication is that the perceived effectiveness of an app led to a positive attitude towards using the application, developing positive intention for using the Firefly Music Festival Mobile App during the festival. Results disprove previous research, which indicated that

while there are aspects of SNT inter-spliced within the work; both shared social identity and Lewin's Equation reinforce the notion that social groups will seek immediate reassurances/guidance from within their social circles before using technology. This phenomenon is indicative of a cohesive identity which may present as early as the response to the event (Cocking, 2013).

Whereas study findings indicate that the PU of an app led to a positive ATU and AU of the Firefly Music Festival Mobile App during the festival, recent research suggests that both SIT and shared social identity are appropriate influencers for the variable SI and compatible within TAM regarding PU, ultimately enhancing the ability and reach of help-seeking behaviors (Cocking, 2013; Drury, 2018; Levine & Manning, 2013). The study findings contribute to the previous empirical literature by indicating that the PU of an app led to a positive ATU of the application, developing positive intention for the actual use of the Firefly Music Festival Mobile App during the festival.

This research affirms the existence of help seeking behaviors and attempts to begin to understand the level of responsibility one shares as a person rendering assistance for OMF attendees. This action coincides with previous literature relative to the After-Action Review (AAR) of the Route 91 Harvest Festival, (FEMA, 2018), Drury et al. (2009a; 2009b); Von Silvers, (2014), discussed within this study.

While the level of inquiry regarding help seeking behaviors fell outside the parameters and intent of the modified TAM, it is reasonable to conclude that festival attendees are afforded ineffable opportunities (that they might not otherwise have), when assisting injured festival goers through the app interface such as, the location of medical tents, mobile alerts, assistance with reunification centers, and the ability to accept new

members within the modified app, to alert other group members. The extent to which communication and coordination can occur through the app function is limited only to imagination and willingness to participate.

## Limitations

The primary limitation of this research was that the phenomenological study relied on one single event type multi-day OMF; (Firefly Music Festival), located in Dover, Delaware, as a foundational assessment of human behavior about technology acceptance modeling while excluding other (notable) East Coast Music Festivals.

This study's non-probability, purposeful sampling method prevented the results from being generalizable from the sample to the target population (Palinkas et al., 2015). Findings from the qualitative component of the study, which included the open-ended questionnaire items, were most credible concerning the sample from which they were drawn, and transferability will depend on comparing the sample profile with the profiles of other instances in which the reader may be interested.

This research did not explore a subset of the population that may be classified as access and functional needs. Such parameters were thought to be beyond the scope of this dissertation. With that in mind, Elize (2022) provided a comprehensive examination concerning vulnerable group members' and group leaders' decision-making for outdoor venues, special events, and the subsequent effect on evacuation times related to safe zones. The work is indeed comprehensive, though it lacks the reunification component, instead opting for unspecified reunification abilities.

This research did not account for how often festival attendees attempted to circumvent the system of legitimate purchases and transfer the RFID-encoded bracelet

that grants access to and from the festival to other individuals. While the geofencing and geolocation software would operate outside the RFID system, using wifi signals, identification of individuals might hamper conflicting data, i.e., RFID data versus social group data.

Human behavior is intricately tied to relational interactions and occurs within a dynamic and ever-changing context (Bieri, 1955; Bronfenbrenner, 1994; Cambel, 1993; Cipresso, 2015; Robertson and Combs, 2014). While the TAM was able to be modified using the external variables, the study's parameters were hampered (in-part) by Lewin's formulaic equation. As such, the parameters regarding the study of human behavior of an OMF became conditional and reciprocal towards technology acceptance research. These issues reveal a complex paradox regarding future pathways for academic exploration and research. Cushing (2013) unequivocally rejects the idea of modeling human behavior based on variables in equations. Bronfenbrenner, (1994) delved into ecological systems theory and developed concentric modeling for behaviors and influencers that is already widely accepted. Meanwhile, Cipresso, (2015) argued for a comprehensive exploration of behaviors' relational, dynamic, and multidimensional aspects, favoring complex system theory. The limitation surrounding these diverse ideas lies in the equation used to explain and understand human behavior.

## Implications

The duality of this research and its findings have wide-reaching implications for festival promoters, incident command teams, and festival attendees that capitalize on human-computer interactions. The results have made additional contributions to the Technology Acceptance Model (TAM) regarding the perceived usefulness of integrated

mobile applications that coincide with SSA and SI. The modified TAM was proven to influence actual use in both emergency and non-emergency situations due to the applications PU/value; thereby empowering all connected parties to make informed decisions beyond a single individual mindset and instead favor the social groups. Were the modified app to be adopted by incident command teams and festival promoters (pre-incident), ideally, the dormant functions that would be enabled (at the onset of the incident) would save considerable time, enhance communication efficiency, and streamline the coordination of emergency responses, and include features such as reunification center notification, alerts, and expected staffing for more comprehensive incident management.

Authorities can use these findings to implement various strategies to enhance security for OMFs because festival attendees are bound by a precarious set of circumstances when forced to determine where to go during an evacuation and how to reunify post-evacuation, given that evacuees may not have viable alternatives for secondary accommodations or be familiar with their surroundings. The importance of evacuation route selection should be expanded to include psychosocial knowledge regarding collective behaviors within social groups in conjunction with shelter/reunification sites (Aradau, 2015).

## Implications Regarding Lewin's Equation

Throughout this dissertation, both theory and research crossed the demarcation line between physical and virtual environments; at times obfuscating where one categorical variable began, and the other ended. The researcher purposefully used the virtual interface within this dissertation, as both a tool within the IoT landscape, as well

as an environment, with a virtual presence (where actions may occur); simply put, the way in which one interacts with their environment can be physical, virtual, social or non-social.

Research supports the notion that "computers are social actors." The studies under the CASA framework have consistently shown that the social principles governing human-human interaction are equally applicable to interactions between humans and computers (Nass, Moon, and Fogg, et al., 1995). This perspective acknowledges the interconnectedness of the physical and virtual environments, challenging the dichotomous perspective between the two (Girvan, 2018; Lehdonvirta, 2010). Lehdonvirta contends that adopting a perspective challenging the dichotomy between virtual and real identity is crucial to avoiding inaccurate assumptions. This perspective aligns with the argument that the virtual environment, as asserted by Chalmers (2017), should not be perceived as inferior or less valuable than the physical (pg. 352). Shields (2003) discerned that it might be more fruitful to contrast the virtual environment with the physical, natural, or material environment.

SSA and SI were used as external variables within the modified TAM, which permitted a new methodology to emerge due to the variable's uniqueness and interchangeability regarding physical and virtual milieu. The social group itself was extensively covered within this dissertation. Findings support the inclusion of social groups moving forward and support the established precedence for its importance (Homans, 2013; Kadushin, 2002; Baumeister and Leary, 1995; Cartwright and Ed Zander, 1968; Jensen, 2003; Turner et al., 1987; Spears, 2021). As a result, the author suggests modifying Lewin's equation $B=f(P,E)$ to account for both physical and virtual

person(s) and their environment(s), which include social and non-social factors; or, B=±*f*([Pp,Ep(Sp,Np)] related to [Pv,Ev(Sv,Nv)]). A breakdown of the variables and the operationalization characteristics are located in Table 21.

The equation operates independently from the TAM; however, the theoretical inclusion of these variables not only broadens perspectives on technology acceptance but also facilitates greater cohesion between the two by incorporating both physical and virtual elements. The expanded equation not only clarifies the limitations of the original Lewinian equation but also contributes to Bandura's reciprocal determinism (1978), emphasizing bidirectional influences among individuals, behaviors, and the environment. Furthermore, it incorporates the concept of social presence as initially proposed by Short et al. (1976) and expanded by Gunawardena & Zittle (1997). Its implications extend across diverse disciplines, including psychology, sociology, communications, criminology, homeland security, political violence, and human behavior modeling.

While Lewin's original equation has been criticized as being overly simple (Burnes, 2020; Colucci, 2018), it is important to note that the equation was developed in 1936, prior to any facsimilia of virtual interfacing technology. Both Bronfenbrenner's (1977) bioecological model of development and Lewin's formula of Human Behavior emphasize the dynamic interplay between individuals and their environments, recognizing that multiple factors influence human behavior and development. While Bronfenbrenner (1977) established environmental realms for interplay e.g. microsystems, mesosystems, exosystems, and macrosystems; they remain abstract in the Lewinian formula and nonexistent for virtual settings. For the sake of both relevance and interoperability between Bronfenbrenner and Lewin, the author would suggest the

inclusion of privacy terms and agreements, and codes of conduct within the social virtual and non-social virtual domain (depending on weather the rules emphasize social engagement). These guidelines would act as indirect influencers within the virtual/digital environment.

The new formula acknowledges the complexity of behavior, emphasizing that it can be either positive or negative based on other variables. This notion is reinforced through the collective work of Moody and White, (2003); Granovetter, (1973); Tajfel and Turner, (1979); Stadtfeld et al. , (2020); and Stark et al., (2013). Suler, (2004) does not explicitly reference Lewin, but does attribute online disinhibition effects to how one might disassociate from the real-world thus allowing for more deviant behaviors to manifest. Additional studies have shown that online gaming platforms allow players from all over the world to play together and chat, often without revealing their real identities. The study found that some players engage in undesirable behavior, such as verbal and sexual harassment, in these virtual environments (Tang and Fox, 2016).

Kihlstrom (2013) discussed the flexible relationship between P and E but does not differentiate how the relationship may manifest, may be nurtured, or what the relationship means for the individual regarding positive or negative emotions and behaviors. White & Hewitt (2023) acknowledge that within the equation proffered by Lewin, that P or E may exacerbate influential tendencies, while also acknowledging the action as being situationally dependent.

The new equation demonstrates a greater, more modernized flexibility between P and E, and thusly illustrates the impact personal identity, environments, social and non-social groups, may have on behavior; be it positive or negative, physical or virtual.

**Table 14**

Expanded Lewinian Equation

| Variable | Operational Characteristics |
|---|---|
| Person Physical (Pp) | biological factors, psychological factors, and social axioms. |
| Person Virtual (Pv) | digital personas, (anonymous and distinctive) digital identities, avatars, patterns of digital/internet interactions, and postings. |
| Environment Physical (Ep) | physical settings, urban/rural environments, infrastructure, and transportation infrastructure. |
| Social Physical (Sp) | social groups (belonging, interdependence, adherence to social norms, adherence to group norms, and assisting in social identity), community organizations, cultural affiliations. |
| Non-social Physical (Np) | locations (geographical), layouts - accessibility, spatial configurations. |
| Environment Virtual (Ev) | digital or virtual environments, augmented reality (AR), geolocation, |
| Social Virtual (Sv) | Virtual social groups/networks, social media, digital interactions, mobile applications/communications that provide social connectivity, artificial intelligence (AI), virtual reality with immersive environments facilitating social presence, virtual meetings, online gaming, culturally connected virtual communities, gifs, emojis, *remote (virtual) work. |
| Non-social Virtual (Nv) | websites, blogs, cellular assisted geographical locations, directions, and points of interest, *remote (virtual) work. |

*Remote work may be either social (Sv) or non-social (Nv) depending on exigent circumstances.

The author contends that physical personas (behavior in the real world) and digital personas may not consistently align. Snyder (1987) also highlighted the inconsistencies between the outward images projected to others and the internal portrayals individuals maintain for themselves. Anonymity through virtual environments is the personification of masked behaviors, akin to what Yee and Bailenson describe as the "Protus Effect," (2007) where the individuals' behaviors are dictated by the characteristics of their virtual avatar. Choosing an avatar's features has explicitly shown to help express oneself, convey social standing, and foster a sense of closeness. Some researchers have also proposed a stronger link between individuals and the digital representations they create (McCreery et al., 2012). The amended formula provides a more comprehensive framework to truly understand the totality of human behavior, particularly in instances where, as posited by Brey (2014) and Reid et al. (2020), digital behavior transcends into the physical world. The systematic arrangement of variables ensures impartial representation, facilitating meaningful comparisons with Bronfenbrenner's model or in real-world case studies, while also acknowledging a virtual/digital environment replete with all the same fundamental constructs that might influence behaviors.

## Recommendations for Future Research

In expanding the scope of the phenomenological study beyond the Firefly Music Festival, there is a need to conduct a comparative analysis across various East and West Coast Music Festivals, adhering to the specified research criteria. This extended exploration would aim to delve deeper into the complexities of human behavior within the context of technology acceptance modeling during multi-day events, with an on-site camping component. Notably, differences in attendee demographics, cultural influences, and organizational structures across diverse festival environments should be examined to gain a more profound understanding of technology acceptance patterns. Questions persist regarding technology acceptance relative to the event's music genre, venue type, or geographic location. Additionally, considering the distinct privacy laws in different countries, future research should focus on how Americans perceive these variations, in order to provide valuable insights into the multifaceted dynamics of technology acceptance in festival settings. Comprehensive studies such as these, would seek to contribute to the existing body of knowledge by unraveling unique aspects of human behavior within the existing context crowds and outdoor music festivals.

This study applied the external variable of SI within the modified TAM. This research successfully measured the external variable against PU and PEOU, which ultimately facilitated a greater understanding regarding AU. Additional research could attempt to measure SI against ATU directly, absent any stimuli or motivation regarding PU or PEOU. Future research could investigate both positive and/or negative associations of SI and how that might relate to ATU, thus affecting the AU of technology acceptance.

Further investigation is warranted to explore the dynamics of social environments, represented by the variables Sp and Sv, and their potential role as agitators, amplifiers, mediators, or moderators in the intricate relationship between personal factors (Pp, Pv) and environmental factors (Ep, Ev). This exploration aligns with Symbolic Interactionism's focus on the symbolic nature of digital interactions in relation to self-identity, collective behavior, and social movements. Research surrounding this formula would be instrumental in uncovering the mechanisms through which social environments impact both positive and negative behaviors, enhancing academia's understanding of the interplay between individual attributes, communication mediums, and environmental contexts within the expanded Lewinian equation.

Exploration into the integration of ride-sharing services like Uber and Lyft in emergency evacuations has the potential to uncover crucial aspects of this evolving capability. Questions regarding the deployment of vehicles for aid, how ride-sharing emergency operation centers deliver relevant information top-down, if/how information is delivered bottom-up, and whether the command or company drivers accept responsibility, particularly in the context of emergencies, poses a significant area for study under the public/private partnership umbrella (P3). Moreover, a comprehensive examination of liability issues in emergencies is key. Determining who bears responsibility for damages to personally owned vehicles, as well as addressing issues related to injury or death during emergency evacuations, is vital for legal and ethical considerations.

A critical focus should be directed towards strategic planning for secondary accommodations, especially when festival grounds become inaccessible, potentially

evolving into crime scenes. This research should intricately explore the legal dimensions of emergency management, including liability, responsibility, and accountability frameworks for event organizers and stakeholders. Investigations into the establishment of robust legal guidelines and ethical standards are essential for ensuring the safety and security of festival attendees during unforeseen events. Additionally, there is a pressing need to delve into studies centered on the provision of essential life survival necessities in the aftermath of such emergencies. This involves optimizing logistics for the efficient delivery of crucial items such as transportation, water, food, personal hygiene products, medications, and sleeping equipment. By comprehensively addressing both the legal and survival aspects, future research endeavors can contribute significantly to enhancing the overall safety and well-being of festival attendees in post-evacuation scenarios that are circumstantially dependent on state or local assistance.

## Conclusion

This study successfully applied Social Identity Theory concepts to a modified Technology Acceptance Model (TAM) for existing application-based software technologies on Android and iOS platforms to facilitate user expectations of reunification efforts for pre-planned or spontaneous evacuations of Outdoor Music Festivals (OMF). The research demonstrated that social identity theory, and by extension, shared social identity theories are compatible, when provided with the correct parametric variables, to a modified TAM. Research findings demonstrated that the perceived usefulness of an app led to a positive attitude towards using the application and thus developing positive intention for actual use of the Firefly Music Festival Mobile App during the festival, by festival attendees. The research demonstrated that the perceived usefulness of the app contributes to the adoption of technology for those attending - thereby empowering individuals within social groups to have the wherewithal to make informed decisions regardless of third-party intervention.

By happenstance, the author successfully inverted the conventional pyramid of responsibility, typically characterized by a rigid hierarchical structure that seeks to both manage and control situations in crisis, to a consumer facilitated, socially responsible pyramid that is inclusive of inter/intra group dynamics and priorities that passively informs incident commanders. The study's findings shed light on the intricacies of evacuations and how human behavior, influenced by technology, can impact a socially responsible reunification process. Moreover, the study also validated such enhancements to Android and iOS platforms are already possible and could aid incident commanders in their respective decision making. Emergency managers must continue to evolve

alongside the current and future asymmetric threats and hazards. Enabling/empowering citizens to triage the threats and hazards they face in “near” real-time is a basic tenet of Maslow's hierarchy of needs.

More U.S.-based studies are needed to examine various factors and strategies for adopting technology that would be beneficial for SSA regarding Outdoor Music Festival events; particularly those that incorporate on site camping components as these individuals may be prone to additional stressors regarding relocation/reunification. Additionally, integrating cross-functional expertise in crowd management, crowd safety, and crowd control is crucial for developing comprehensive approaches to ensure the well-being and security of attendees in such dynamic environments.

# APPENDICES

## Appendix A: St. John's University IRB Approval Letter

ST. JOHN'S UNIVERSITY

Federal Wide Assurance: FWA00009066

Mar 23, 2023 3:09:02 PM EDT

PI: Justin Puchalsky
CO-PI: Bernard Jones
Users loaded with unmatched Organization affiliation., Crim Jus, Leg Stud & Hmlnd Sec

Re: Expedited Review - Initial - **IRB-FY2023-268** *OPTIMIZATION OF REUNIFICATION CAPABILITIES AT OUTDOOR MUSIC FESTIVALS: EMPOWERING SOCIAL GROUPS TO MAINTAIN SITUATIONAL AWARENESS THROUGH GEOFENCING AND GEOLOCATION*

Dear Justin Puchalsky:

The St John's University Institutional Review Board has rendered the decision below for *OPTIMIZATION OF REUNIFICATION CAPABILITIES AT OUTDOOR MUSIC FESTIVALS: EMPOWERING SOCIAL GROUPS TO MAINTAIN SITUATIONAL AWARENESS THROUGH GEOFENCING AND GEOLOCATION*. The approval is effective from March 23, 2023 through --.

Decision: Exempt

PLEASE NOTE: If you have collected any data prior to this approval date, the data must be discarded.

Selected Category: Category 2.(i). Research that only includes interactions involving educational tests (cognitive, diagnostic, aptitude, achievement), survey procedures, interview procedures, or observation of public behavior (including visual or auditory recording).
The information obtained is recorded by the investigator in such a manner that the identity of the human subjects cannot readily be ascertained, directly or through identifiers linked to the subjects.

Sincerely,

Raymond DiGiuseppe, PhD, ABPP
Chair, Institutional Review Board
Professor of Psychology

# Appendix B: Informed Consent Group A


**Informed Consent Document**

For the research study:

***OPTIMIZATION OF REUNIFICATION CAPABILITIES AT OUTDOOR MUSIC FESTIVALS: EMPOWERING SOCIAL GROUPS TO MAINTAIN SITUATIONAL AWARENESS THROUGH GEOFENCING AND GEOLOCATION***

This study is being conducted by Justin Puchalsky, a DPS Candidate at St. John's University. Dr. Bernard Jones, Professor of Homeland Security and Emergency Management is overseeing the research.

Please read this form carefully as it will inform you about your rights within this study. Ask questions if you want more information about this form or the study by emailing Justin Puchalsky at justin.puchalsky20@my.stjohns.edu or Dr. Bernard Jones at jonesb1@stjohns.edu.

If you decide to participate in this study, you will sign this form – make sure you understand it completely before signing. Keep a copy of this form for your records.

**What is this study about?**

This study will examine the importance of the social group in relation to evacuation and reunification while in attendance of multi-day Outdoor Music Festivals; specifically, Firefly Music Festival located in Dover, Delaware.

**Who are we asking to participate?**

Anyone at least 18 years old, who has attended Firefly Music Festival in the past.

**What will you be asked to do?**

There are three parts to this study: Supplemental (background information and demographics), decision making/ situational questions, and opinion-based technology assistance questions. All three sections are necessary in order to log your responses for inclusion. Are there any possible risks to you?

There are no risks to you should you choose to participate in the study. Some questions may make you feel uncomfortable, as they are intended to be situational responses. If you have never been in a situation that has required evacuation or reunification the idea is abstract.

Your participation in the survey will not collect any personally identifiable information.

**Will you benefit from participation?**

While there are no financial incentives to participate in the survey the hope is to understand the expectation of festival goers while in attendance of Outdoor Music Festivals such as Firefly Music Festival.

**Will it cost you anything to participate?**

Time is a valuable commodity. This survey will only ask for your time.

**Will you receive anything for participating in the study?**
No.

**How will we keep your information private?**
Your participation in the survey will not collect any personally identifiable information.

**What will happen with your answers after this study?**
Quantifiable information will be stored for future publications.

The data derived from your answers may be used in future publications and/or requested by other researchers. You may decline to share the data below.

**What if you don't want to participate or change your mind partway through?**

Participating in this study is completely voluntary. You can refuse to participate or quit at any time.

**Who can you call if you have more questions?**

If you have any questions about the research or your participation in the study, feel free to contact Justin Puchalsky at justin.puchalsky20@my.stjohns.edu or Dr. Bernard Jones at jonesb1@stjohns.edu.

This research was approved by an office/committee that oversees the ethics of human subjects research at St. John's University. If you have any questions about your rights – or if you have concerns about the study – you may contact them at 781-736-8133 or hrpp@brandeis.edu

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**Subject Consent**

I have read this consent form completely. I have been encouraged to ask questions, and have received helpful answers. I understand that:

- My participation is voluntary
- I may quit at any time without penalty

☐ I do ☐ I do not give you permission to share my answers – with no identifying information – with other researchers for future studies.

By signing this form, I agree to not share what is said in the group discussion with anyone not part of the group.

I voluntarily agree to participate in this study.

Participant's Signature_____Date _____

Investigator's Signature_____Date _____

# Appendix C: Introduction Letter to Panel Experts

**Introduction Letter to Expert Panel Members: Group B**

ST. JOHN'S UNIVERSITY

March 10, 2023

Good day:

My name is Justin Andrew Puchalsky, I am a doctoral candidate at St John's University's Lesley H. and William L. Collins College of Professional Studies: Criminal Justice, Legal Studies and Homeland Security Division. I am also an Emergency Management Professional with the Delaware Emergency Management Agency. I am requesting your assistance and participation in a survey.

My dissertation will evaluate the feasibility of hypothetical modifications to web-based mobile platforms for Android and IOS users to aid in social groups reunification efforts when displaced. I am hopeful that the results of this research, informed by the Science and Technology branch at FEMA and the Alerts & Warnings section will assist in bridging the gap between academia and practitioners respective of homeland security regarding Soft Targets/Crowded Places.

The amount of time, effort, and resources involved in your participation as a Subject Matter Expert will be minimal. The survey itself is anonymous and you will not be asked to furnish any biographical data that can identify you. Once you have completed and submitted the survey, please evaluate the survey by clicking the second link below to the survey evaluation rubric. Your name will remain confidential and will not be included in and documents published with my dissertation.

The data collected from this survey will be used for completion of my doctoral dissertation. It is not being conducted or sponsored by any government agency. Your participation is purely voluntary; however, it would be greatly appreciated and considered a valuable contribution to this research project.

It is my sincere hope that the information gained from this research will aid academia and homeland security practitioners alike, achieve their mission to protect citizens and first responders, while simultaneously de-conflicting complex problems for incident commanders by empowering social groups to make informed decisions regarding evacuation and reunification in the setting of Soft Targets/Crowded Places.

I thank you in advance for considering this request and hope you agree to participate in this research project by copying and pasting the link provided into your preferred web browser https://www.surveymonkey.com/r/5WP6KL5. If there is anything about the study or your participation that is unclear or that you do not understand, if you have questions or wish to report a research-related problem, you may contact me at 302-538-1186, justin.puchalsky20@my.stjohns.edu or my faculty sponsor, Doctor Bernard Jones, at 718-390-4176, jonesb1@stjohns.edu. For questions about your rights as a research participant, you may contact the University's Institutional Review Board, St. John's University, Dr. Raymond DiGiuseppe, Chair digiuser@stjohns.edu 718-990-1955 or Christina Costello, IRB Coordinator, costellc@stjohns.edu 718-990-6276.

Thank you and Stay Safe!

Justin Andrew Puchalsky
Doctoral Candidate, St John's University

## Appendix D: Introduction Letter Festival Attendees Group A

**Introduction Letter Festival Attendees: Group A**

ST. JOHN'S UNIVERSITY

March 10, 2023

Good day:

My name is Justin Andrew Puchalsky, I am a doctoral candidate at St. John's University's Lesley H. and William L. Collins College of Professional Studies: Criminal Justice, Legal Studies and Homeland Security Division. I am also an Emergency Management Professional with the Delaware Emergency Management Agency. I am conducting a study on Firefly Music Festival in order to aid in the festival experience for attendees.

My dissertation will evaluate the feasibility of hypothetical modifications to the Firefly Music Festival application which operates on mobile platforms for Android and IOS users to aid in social groups reunification efforts when displaced. I am hopeful that the results of this research, informed by festival attendees will ultimately aid the festival experience for attendees and empower attendees to make informed decisions regarding reunification of friends and family members.

The amount of time, effort, and resources involved in your participation as someone who attends the festival as a guest is highly valued. Firefly Music Festival is a unique multi-year festival located on the East Coast with an on-site camping component. The survey itself is anonymous and you will not be asked to furnish any biographical data that can identify you.

The data collected from this survey will be used for completion of my doctoral dissertation. It is not being conducted or sponsored by any government agency. Your participation is purely voluntary. If you consent to take part in this research study you may discontinue the survey at any time, for any reason without penalty. This survey is strictly volunatary.

I thank you in advance for considering this request and hope you agree to participate in this research project by copying and pasting this link into your preferred web browser: https://www.surveymonkey.com/r/Q9TQCJ8 If there is anything about the study or your participation that is unclear or that you do not understand, if you have questions or wish to report a research-related problem, you may contact me at 302-538-1186, justin.puchalsky20@my.stjohns.edu or my faculty sponsor, Dr, Bernard Jones, at 718-390-4176, jonesb1@stjohns.edu. For questions about your rights as a research participant, you may contact the University's Institutional Review Board, St. John's University, Dr. Raymond DiGiuseppe, Chair digiuser@stjohns.edu 718-990-1955 or Christina Costello, IRB Coordinator, costellc@stjohns.edu 718-990-6276.

Thank you and Stay Safe!

Justin Andrew Puchalsky
Doctoral Candidate, Saint John's University

Appendix E: Informed-consent Group B


**Informed Consent Document**

For the research study:

***OPTIMIZATION OF REUNIFICATION CAPABILITIES AT OUTDOOR MUSIC FESTIVALS: EMPOWERING SOCIAL GROUPS TO MAINTAIN SITUATIONAL AWARENESS THROUGH GEOFENCING AND GEOLOCATION***

This study is being conducted by Justin Puchalsky, a DPS Candidate at St. John's University. Dr. Bernard Jones, Professor of Homeland Security and Emergency Management is overseeing the research.

Please read this form carefully as it will inform you about your rights within this study. Ask questions if you want more information about this form or the study by emailing Justin Puchalsky at justin.puchalsky20@my.stjohns.edu or Dr. Bernard Jones at jonesb1@stjohns.edu.

If you decide to participate in this study, you will sign this form – make sure you understand it completely before signing. Keep a copy of this form for your records.

**What is this study about?**

Overall, this study will examine the importance of the social group in relation to evacuation and reunification while in attendance of multi-day Outdoor Music Festivals; specifically, Firefly Music Festival located in Dover, Delaware. As Subject Matter Experts (SME), with Group B, your portion of the study will examine the feasibility of adapting hypothetical modifications to the existing Firefly Music Festival app, determining if this would change the Privacy Terms and Agreements already established by Firefly Music Festival, and if the acceptance of said technology might aid Incident Commanders and or first/emergency responders.

**Who are we asking to participate?**

Federal Emergency Management Agency (FEMA) employees from the Science and Technology Division and Alerts & Warnings Section(s). These participants should be vetted as Subject Matter Experts (SME), within their field.

**What will you be asked to do?**

There are three parts to this study: Supplemental (background information and demographics), decision making/ situational questions, and opinion-based technology assistance questions. All three sections are necessary in order to log your responses for inclusion.

**Are there any possible risks to you?**

There are no risks to you should you choose to participate in the study. Your participation in the survey will not collect any personally identifiable information.

**Will you benefit from participation?**

Time is a valuable commodity. This survey will only ask for your time.

There is no compensation for participation in the survey.

**Will it cost you anything to participate?**

**No.**

**Will you receive anything for participating in the study?**
No.

**How will we keep your information private?**
Your participation in the survey will not collect any personally identifiable information.

**What will happen with your answers after this study?**
Quantifiable information will be stored for future publications.

The data derived from your answers may be used in future publications and/or requested by other researchers. You may decline to share the data below.

**What if you don't want to participate or change your mind partway through?**

Participating in this study is completely voluntary. You can refuse to participate or quit at any time.

**Who can you call if you have more questions?**

If you have any questions about the research or your participation in the study, feel free to contact Justin Puchalsky at justin.puchalsky20@my.stjohns.edu or Dr. Bernard Jones at jonesb1@stjohns.edu.

This research was approved by an office/committee that oversees the ethics of human subjects research at St. John's University. If you have any questions about your rights – or if you have concerns about the study – you may contact them at 781-736-8133 or hrpp@brandeis.edu

**Subject Consent**

I have read this consent form completely. I have been encouraged to ask questions, and have received helpful answers. I understand that:

- My participation is voluntary
- I may quit at any time without penalty

☐ I do ☐ I do not give you permission to share my answers – with no identifying information – with other researchers for future studies.

By signing this form, I agree to not share what is said in the group discussion with anyone not part of the group.

I voluntarily agree to participate in this study.

Participant's Signature_____Date _____

Investigator's Signature_____Date _____

## Appendix F: Tables

### Table F1

Question Items of Survey

| Measure | Item |
|---|---|
| Actual Use | Before downloading the Firefly Music Festival app, did you read the Privacy Terms and Conditions? |
| Actual Use | When did you download the Firefly Music Festival app? Choose the answer that best describes your experience. |
| Attitude Towards Use | Would you be willing to allow the Firefly Music Festival App to access the same data as Facebook, Instagram, Snapchat, WhatsApp, and/or Twitter, if it aided in your perception of increased safety or security for yourself and your group? |
| Attitude Towards Use | Every year, thousands of people attend Firefly. Would you have any interest in the ability to join additional social groups via the Firefly Music Festival App to track new friends' locations during the festival? |
| Attitude Towards Use | Would you be willing to allow the Firefly Music Festival app to access the same data that apps such as Facebook, Instagram, Snapchat, WhatsApp, and/or Twitter do, if you found value in the app? |
| Perceived Ease of Use | Did you personally utilize the Firefly Music Festival Mobile App during the festival? |
| Perceived Usefulness | Did you travel/arrive with friends to Firefly Music Festival? |
| Perceived Usefulness | Did you meet up with friends after arriving to Firefly Music Festival? |
| Perceived Usefulness | Would you be more likely to utilize the app if you could view/follow your friends' current location within the festival? |
| Perceived Usefulness | Would you be more likely to utilize the app if you could view/follow your friends' location within the festival campground? |
| Perceived Usefulness | If the modified Firefly Music Festival App provided a "pin location" to mark your campsite or areas of interest, how likely would you be to use the app? |
| Perceived Usefulness | If the Firefly Music Festival App was able to show key areas (such as medical tents, relocation centers, lost and found locations, or cell phone charging stations) in relation to your location, would you be more likely to use the app? |
| Perceived Usefulness | If the Firefly Music Festival App provided you with pre-staged ridesharing/bus locations in relation to your location, would you be more likely to use the app? |
| Perceived Usefulness | Would you be more likely to use the Firefly Music Festival App if you could interact with your friends through it with a text/messaging function? |

| | |
|---|---|
| Perceived Usefulness | While at Firefly Music Festival, your friend calls you worried about their safety. You can see their location through the Firefly Music Festival App. Would you find it beneficial if the app also had a function where you could relay this information to security |
| Perceived Usefulness | Knowledge of the situation (authority providing details) |
| Perceived Usefulness | Seriousness of the situation |
| Perceived Usefulness | Influence of other attendees (witnessed actions/communications) |
| Perceived Usefulness | Having accessible information (technology) |
| Situational Spatial Awareness | I would move to an area outside the festival where I felt safe |
| Situational Spatial Awareness | I would move to an area inside the festival to avoid crowds |
| Situational Spatial Awareness | I would delay and wait for festival instructions |
| Situational Spatial Awareness | I would delay, call/text to find out what my friends were doing (where they were going) |
| Situational Spatial Awareness | I would focus on packing up my belongings and leaving |
| Situational Spatial Awareness | I would move to an area outside the festival where I felt safe |
| Situational Spatial Awareness | I would move to an area inside the festival to avoid the crowds |
| Situational Spatial Awareness | I would immediately follow the festival's instructions |
| Situational Spatial Awareness | Do you trust authority's instructions enough to listen/follow without making contact with your friends/group during an evacuation prior to reunification? |
| Situational Spatial Awareness | Leave the immediate vicinity |
| Situational Spatial Awareness | Try to text/call my friends to make sure they are okay |
| Situational Spatial Awareness | Locate law enforcement/security to find out more information |
| Situational Spatial Awareness | I would make my way over to the reunification center |
| Situational Spatial Awareness | Do you remember seeing any signage regarding evacuation routes during your time at Firefly Music Festival? |
| Situational Spatial Awareness | When you attended Firefly Music Festival, did you know where the relocation center was located in the event of a planned or unplanned evacuation? |
| Social Influence | I would delay, call/text to find out what my friends were doing (where they were going) |
| Social Influence | I would focus on packing up my belongings and leaving |
| Social Influence | I would wait outside the festival to see if I could locate my social group/friends |
| Social Influence | Call friends, tell them where we can meet |
| Social Influence | Text friends, tell them where we can meet |
| Social Influence | Get to safety first, call/text when I feel I am safe |
| Social Influence | Look for festival security/law enforcement to protect me |

**Table F2**

Perceived Usefulness Item Responses

| Item | *F* | % |
|---|---|---|
| Did you travel/arrive with friends to Firefly Music Festival? | | |
| Yes | 303 | 79.7 |
| No | 77 | 20.3 |
| Did you meet up with friends after arriving to Firefly Music Festival? | | |
| Yes | 306 | 80.5 |
| No | 74 | 19.5 |
| Would you be more likely to utilize the app if you could view/follow your friends' current location within the festival? | | |
| Yes | 234 | 61.6 |
| No | 58 | 15.3 |
| Maybe | 88 | 23.2 |
| Would you be more likely to utilize the app if you could view/follow your friends' location within the festival campground? | | |
| Yes | 229 | 60.3 |
| No | 62 | 16.3 |
| Maybe | | |

| | | |
|---|---|---|
| | 89 | 23.4 |
| If the modified Firefly Music Festival App provided a "pin location" to mark your campsite or areas of interest, how likely would you be to use the app? | | |
| Very likely | 133 | 35.0 |
| Likely | 122 | 32.1 |
| Neutral | 72 | 18.9 |
| Unlikely | 27 | 7.1 |
| Very unlikely | 26 | 6.8 |
| If the Firefly Music Festival App was able to show key areas (such as medical tents, relocation centers, lost and found locations, or cell phone charging stations) in relation to your location, would you be more likely to use the app? | | |
| Yes | 337 | 88.7 |
| No | 43 | 11.3 |
| If the Firefly Music Festival App provided you with pre-staged ridesharing/bus locations in relation to your location, would you be more likely to use the app? | | |
| Yes | 267 | 70.3 |
| No | 113 | 29.7 |

| | | |
|---|---|---|
| Would you be more likely to use the Firefly Music Festival App if you could interact with your friends through it with a text/messaging function? | | |
| Yes | 226 | 59.5 |
| No | 154 | 40.5 |
| While at Firefly Music Festival, your friend calls you worried about their safety. You can see their location through the Firefly Music Festival App. Would you find it beneficial if the app also had a function where you could relay this information to security? | | |
| Yes | 276 | 72.6 |
| No | 40 | 10.5 |
| Maybe | 64 | 16.8 |
| Rank the importance of Knowledge of the situation (authority providing details) | | |
| 1 (Most Important) | 161 | 42.4 |
| 2 (Second most important) | 140 | 36.8 |
| 3 (Third most important) | 69 | 18.2 |
| 4 (Least Important) | 10 | 2.6 |
| Rank the importance of Seriousness of the situation | | |
| 1 (Most Important) | 149 | 39.2 |
| 2 (Second most | 149 | 39.2 |

| | | |
|---|---|---|
| important) | 70 | 18.4 |
| 3 (Third most important) | 12 | 3.2 |
| 4 (Least Important) | | |
| Rank the importance of Influence of other attendees (witnessed actions/communications) | | |
| 1 (Most Important) | 15 | 3.9 |
| 2 (Second most important) | 29 | 7.6 |
| 3 (Third most important) | 76 | 20.0 |
| 4 (Least Important) | 260 | 68.4 |
| Rank the importance of Having accessible information (technology) | | |
| 1 (Most Important) | 55 | 14.5 |
| 2 (Second most important) | 62 | 16.3 |
| 3 (Third most important) | 165 | 43.4 |
| 4 (Least Important) | 98 | 25.8 |

**Table F3**

Situational Spatial Awareness

| | *f* | % |
|---|---|---|
| Rank your immediate actions: I would move to an area outside the festival where I felt safe | | |
| 1 (Most Important) | 166 | 43.7 |
| 2 (Second most important) | 71 | 18.7 |
| 3 (Third most important) | 53 | 13.9 |
| 4 (Fourth most important) | 68 | 17.9 |
| 5 (Least Important) | 22 | 5.8 |
| Rank your immediate actions: I would move to an area inside the festival to avoid crowds | | |
| 1 (Most Important) | 87 | 22.9 |

| | *f* | % |
|---|---|---|
| 2 (Second most important) | 107 | 28.2 |
| 3 (Third most important) | 73 | 19.2 |
| 4 (Least Important) | 61 | 16.1 |
| | 52 | 13.7 |
| Rank your immediate actions: I would delay and wait for festival instructions | | |
| 1 (Most Important) | 38 | 10.0 |
| 2 (Second most important) | 81 | 21.3 |
| 3 (Third most important) | 121 | 31.8 |
| 4 (Fourth most important) | 95 | 25.0 |
| 5 (Least Important) | 45 | 11.8 |
| Rank your immediate actions: I would delay, call/text to find out what my friends were doing (where they were going) | | |
| 1 (Most Important) | 64 | 16.8 |
| 2 (Second most important) | 85 | 22.4 |
| 3 (Third most important) | 97 | 25.5 |
| 4 (Fourth most important) | 100 | 26.3 |
| 5 (Least Important) | 34 | 8.9 |
| Rank your immediate actions: I would focus on packing up my belongings and leaving | | |
| 1 (Most Important) | 25 | 6.6 |
| 2 (Second most important) | 36 | 9.5 |
| 3 (Third most important) | 36 | 9.5 |
| 4 (Fourth most important) | 56 | 14.7 |
| 5 (Least Important) | 227 | 59.7 |
| Rank your immediate actions: I would move to an area outside the festival where I felt safe | | |
| 1 (Most Important) | 142 | 37.4 |
| 2 (Second most important) | 132 | 34.7 |
| 3 (Third most important) | 54 | 14.2 |
| 4 (Fourth most important) | 49 | 12.9 |
| 5 (Least Important) | 3 | 0.8 |
| Rank your immediate actions: I would move to an area inside the festival to avoid the crowds | | |
| 1 (Most Important) | 42 | 11.1 |
| 2 (Second most important) | 69 | 18.2 |
| 3 (Third most important) | 111 | 29.2 |
| 4 (Fourth most important) | 80 | 21.1 |
| 5 (Least Important) | 78 | 20.5 |
| Rank your immediate actions: I would immediately follow the festival's instructions | | |
| 1 (Most Important) | 155 | 40.8 |
| 2 (Second most important) | 102 | 26.8 |

| | *f* | % |
|---|---|---|
| 3 (Third most important) | 80 | 21.1 |
| 4 (Fourth most important) | 35 | 9.2 |
| 5 (Least Important) | 8 | 2.1 |
| Do you trust authority's instructions enough to listen/follow without making contact with your friends/group during an evacuation prior to reunification? | | |
| Yes | 249 | 65.5 |
| No | 131 | 34.5 |
| Rank your immediate actions: Leave the immediate vicinity | | |
| 1 (Most Important) | 132 | 34.7 |
| 2 (Second most important) | 65 | 17.1 |
| 3 (Third most important) | 60 | 15.8 |
| 4 (Fourth most important) | 62 | 16.3 |
| 5 (Least Important) | 61 | 16.1 |
| Rank your immediate actions: Try to text/call my friends to make sure they are okay | | |
| 1 (Most Important) | 199 | 52.4 |
| 2 (Second most important) | 105 | 27.6 |
| 3 (Third most important) | 54 | 14.2 |
| 4 (Fourth most important) | 19 | 5.0 |
| 5 (Least Important) | 3 | 0.8 |
| Rank your immediate actions: Locate law enforcement/security to find out more information | | |
| 1 (Most Important) | 20 | 5.3 |
| 2 (Second most important) | 95 | 25.0 |
| 3 (Third most important) | 101 | 26.6 |
| 4 (Fourth most important) | 111 | 29.2 |
| 5 (Least Important) | 53 | 13.9 |
| Rank your immediate actions: I would make my way over to the reunification center | | |
| 1 (Most Important) | 12 | 3.2 |
| 2 (Second most important) | 46 | 12.1 |
| 3 (Third most important) | 100 | 26.3 |
| 4 (Fourth most important) | 112 | 29.5 |
| 5 (Least Important) | 110 | 28.9 |
| Do you remember seeing any signage regarding evacuation routes during your time at Firefly Music Festival? | | |
| Yes | 96 | 25.3 |
| No | 284 | 74.7 |
| When you attended Firefly Music Festival, did you know where the relocation center was located in the event of a planned or unplanned evacuation? | | |
| Yes | 84 | 22.1 |
| No | 296 | 77.9 |

**Table F4**

Social Influence Item Responses

| Item | *f* | % |
|---|---|---|
| I would delay, call/text to find out what my friends were doing (where they were going) | | |
| 1 Very likely | 25 | 6.6 |
| 2 Likely | 53 | 13.9 |
| 3 Neither likely nor unlikely | 96 | 25.3 |
| 4 Unlikely | 164 | 43,2 |
| 5 Very unlikely | 42 | 11.1 |
| I would focus on packing up my belongings and leaving | | |
| 1 Very likely | 16 | 4.2 |
| 2 Likely | 24 | 6.3 |
| 3 Neither likely nor unlikely | 39 | 10.3 |
| 4 Unlikely | 52 | 13.7 |
| 5 Very unlikely | 249 | 65.5 |
| I would wait outside the festival to see if I could locate my social group/friends | | |
| 1 Very likely | 17 | 4.5 |
| 2 Likely | 69 | 18.2 |
| 3 Neither likely nor unlikely | 65 | 17.1 |
| 4 Unlikely | 76 | 20.0 |
| 5 Very unlikely | 153 | 40.3 |
| Call friends, tell them where we can meet | | |
| 1 Very likely | 91 | 23.9 |
| 2 Likely | 126 | 33.3 |
| 3 Neither likely nor unlikely | 127 | 33.4 |
| 4 Unlikely | 36 | 9.5 |
| 5 Very unlikely | 0 | 0 |
| Text friends, tell them where we can meet | | |
| 1 Very likely | 78 | 20.5 |
| 2 Likely | 165 | 43.4 |
| 3 Neither likely nor unlikely | 98 | 25.8 |
| 4 Unlikely | 39 | 10.3 |
| 5 Very unlikely | 0 | 0 |
| Get to safety first, call/text when I feel I am safe | | |
| 1 Very likely | 199 | 52.4 |
| 2 Likely | 47 | 12.4 |
| 3 Neither likely nor unlikely | 104 | 27.4 |
| 4 Unlikely | 30 | 7.9 |
| 5 Very unlikely | 0 | 0 |
| Look for festival security/law enforcement to protect me | | |
| 1 Very likely | 12 | 3.2 |
| 2 Likely | 42 | 11.1 |

| Item | *f* | % |
|---|---|---|
| 3 Neither likely nor unlikely | 51 | 13.4 |
| 4 Unlikely | 275 | 72.4 |
| 5 Very unlikely | 0 | 0 |

**Table F5**

Attitude towards Use Item Responses

| Item | *f* | % |
|---|---|---|
| Would you be willing to allow the Firefly Music Festival App to access the same data as Facebook, Instagram, Snapchat, WhatsApp, and/or Twitter, if it aided in your perception of increased safety or security for yourself and your group? | | |
| Yes | 195 | 51.3 |
| No | 74 | 19.5 |
| Every year, thousands of people attend Firefly. Would you have any interest in the ability to join additional social groups via the Firefly Music Festival App to track new friends' locations during the festival? | | |
| 1 Extremely interested | | |
| 2 Very interested | 75 | 19.7 |
| 3 Somewhat interested | 47 | 12.4 |
| 4 Not so interested | 127 | 33.4 |
| 5 Not at all interested | 75 | 19.7 |
| | 56 | 14.7 |

| | | | |
|---|---|---|---|
| Would you be willing to allow the Firefly Music Festival app to access the same data that apps such as Facebook, Instagram, Snapchat, WhatsApp, and/or Twitter do, if you found value in the app? | | | |
| Yes | 147 | 38.7 | |
| No | 95 | 25.0 | |

**Table F6**

Chi-Square test Results and Perceived Use Items

| Item | *χ2* | *df* | *p* |
|---|---|---|---|
| Did you travel/arrive with friends to Firefly Music Festival? | 5.983 | 4 | 0.2 |
| Did you meet up with friends after arriving to Firefly Music Festival? | 4.333 | 4 | 0.363 |
| Would you be more likely to utilize the app if you could view/follow your friends' current location within the festival? | 106.454 | 8 | <.001 |
| Would you be more likely to utilize the app if you could view/follow your friends' location within the festival campground? | 95.739 | 8 | <.001 |
| If the modified Firefly Music Festival App provided a "pin location" to mark your campsite or areas of interest, how likely would you be to use the app? | 243.769 | 16 | <.001 |
| If the Firefly Music Festival App was able to show key areas (such as medical tents, relocation centers, lost and found locations, or cell phone charging stations) in relation to your location, would you be more likely to use the app? | 18.291 | 4 | <.001 |
| If the Firefly Music Festival App provided you with pre-staged ridesharing/bus locations in relation to your location, would you be more likely to use the app? | 48.365 | 4 | <.001 |

| | | | |
|---|---|---|---|
| Would you be more likely to use the Firefly Music Festival App if you could interact with your friends through it with a text/messaging function? | 69.286 | 4 | <.001 |
| While at Firefly Music Festival, your friend calls you worried about their safety. You can see their location through the Firefly Music Festival App. Would you find it beneficial if the app also had a function where you could relay this information to security | 36.959 | 8 | <.001 |
| Knowledge of the situation (authority providing details) | 21.002 | 12 | <.001 |
| Seriousness of the situation | 19.811 | 12 | 0.071 |
| Influence of other attendees (witnessed actions/communications) | 26.6 | 12 | 0.009 |
| Having accessible information (technology) | 31.709 | 12 | 0.002 |

*Note*: Table F6 provides information related to the interest in the ability to join additional social groups via the Firefly Music Festival App to track new friends' locations during the festival.

**Table F7**

SME Survey Item Responses

| Item | | *n* | *%* |
|---|---|---|---|
| Can the current Firefly Music Festival App design and configuration be modified? | A lot | 7 | 58.3% |
| | A moderate amount | 2 | 16.7% |
| | Completely | 2 | 16.7% |
| | Not at all | 1 | 8.3% |
| Could the Firefly Music Festival App be modified to include geofencing/geolocation updates of festival attendees' locations? | No | 1 | 8.3% |
| | Yes | 11 | 91.7% |
| Would geofencing and/or geolocation additions alter the already established privacy policy settings for Firefly Music Festival Mobile App? | A little | 5 | 41.7% |
| | A lot | 2 | 16.7% |
| | A moderate amount | 2 | 16.7% |
| | Completely | 1 | 8.3% |
| | None at all | 2 | 16.7% |

| Item | | *n* | *%* |
|---|---|---|---|
| Can mobile apps be modified to allow social groups to track each other's location(s) and display said location(s) over a map feature? | Yes | 12 | 100.0% |
| Can mobile apps be modified in such a way that users could drop a pin on their location, accessible only by other users within the same social group? | Yes | 12 | 100.0% |
| Can mobile apps be modified in such a way that would allow for pre-identified locations to be dormant or active as the situation dictates by the Command Team? | No | 1 | 8.3% |
| | Yes | 11 | 91.7% |
| Would location tracking alter the already-established privacy policy settings for Firefly Music Festival Mobile App users? | A little | 3 | 25.0% |
| | A lot | 2 | 16.7% |
| | A moderate amount | 4 | 33.3% |
| | Completely | 2 | 16.7% |
| | None at all | 1 | 8.3% |
| Is it possible to allow users interfacing with a modified app to raise concerns (e.g., suspicious persons, unconscious individual, bus location, Uber/Lyft location, medical or EMS locations, etc.) directly to designated law enforcement/security personnel? | Yes | 12 | 100.0% |
| How likely is it that the app can be modified so that | Likely | 9 | 75.0% |
| | Neither likely nor unlikely | 1 | 8.3% |

| Item | | *n* | *%* |
|---|---|---|---|
| individuals within social groups can share their location with multiple (other) social groups simultaneously? | Very likely | 2 | 16.7% |
| Could modifications to the existing Firefly Music Festival app support a text function between members within the social group? | No | 1 | 8.3% |
| | Yes | 11 | 91.7% |
| Would the addition of a text function within the Firefly Music Festival App alter the established Privacy Policy settings for users? | A little | 3 | 25.0% |
| | A lot | 5 | 41.7% |
| | A moderate amount | 3 | 25.0% |
| | Completely | 1 | 8.3% |
| From a Science and Technology perspective, how valuable would geolocation/geofencing data for festival attendees be for the Incident Command team in providing a real-time operational picture?*Firefly Music Festival annually hosts 50,000 festival attendees | Extremely valuable | 3 | 25.0% |
| | Very valuable | 9 | 75.0% |
| From a Science and Technology perspective, if an incident were to occur at an Outdoor Music Festival prompting an evacuation, could geolocation/geofencing software potentially aid first/emergency responders in locating lost or missing individuals? | A lot | 6 | 50.0% |
| | A moderate amount | 2 | 16.7% |
| | Completely | 4 | 33.3% |
| With respect to Soft Targets/Crowded Places and | Immense value | 3 | 25.0% |
| | Some value | 1 | 8.3% |

| Item | | *n* | *%* |
|---|---|---|---|
| situational awareness, do you see value in a social groups ability to have access to each other's location where the possibility of a planned on unplanned evacuations exist? | Strong value | 8 | 66.7% |
| Post evacuation: If an Incident Commander decided to establish a reunification center for evacuees, would it be helpful to pin the location (within the modified app) for attendees that may not be familiar with the surrounding area outside the festival group | Extremely helpful | 6 | 50.0% |
| | Somewhat helpful | 1 | 8.3% |
| | Very helpful | 5 | 41.7% |
| If social groups were empowered through the hypothetical modifications to the existing Firefly Music Festival app, how likely is it that the potential capacity of expected person(s) requiring an official reunification center could be reduced? | Likely | 4 | 33.3% |
| | Neither likely nor unlikely | 8 | 66.7% |

## REFERENCES


Abdullah, A., Tahir, Z., Yusoff, N. H., & Andrew, F. T. (2022). Effect of Social Media Usage on The Lifestyles of Youth. *E-bangi, 19*(4), 60-69.

Abreu-Novais, M., & Arcodia, C. (2013). Music festival motivators for attendance: Developing an agenda for research. International Journal of Event Management Research, 8(1), 34–48.

Abualsaud, K., Elfouly, T. M., Khattab, T., Yaacoub, E., Ismail, L. S., Ahmed, M. H., & Guizani, M. (2018). A survey on mobile crowd-sensing and its applications in the IoT era. *Ieee access*, *7*, 3855-3881.

Abusch-Magder, D., Bosch, P., Klein, T.E., Polakos, P.A., Samuel, L.G., & Viswanathan, H. (2007). "911-NOW: A network on wheels for emergency response and disaster recovery operations," in *Bell Labs Technical Journal*, vol. 11, no. 4, pp. 113-133. https://doi.org/10.1002/bltj.20199

AEG Presents, (2022). Festivals. Retrieved, https://www.aegpresents.com/festivals/

Aguirre, B.E. (2005). Commentary on 'understanding mass panic and other collective responses to threat and disaster': Emergency evacuations, panic, and social psychology. Psychiatry, 68, 121 - 129.

Aguirre, B. E., El-Tawil, S., Best, E., Gill, K. B. , & Fedorov, V. (2011). Contributions of social science to agent-based models of building evacuation. Contemporary Social Science, 6, 415–432. https://doi.org/10.1080/21582041.2011.609380

Al-Ghaith, W. (2021). Emerging Applications on Smart Phones: The Role of Privacy Concerns and its Antecedents on Smart Phones Usage. *International Journal of Computer Science & Information Technology (IJCSIT) Vol*, *13*.

Aldo, R. (2004): The causes and prevention of serious crowd injury and fatalities at outdoor music festivals. CQUniversity. Conference contribution. https://hdl.handle.net/10018/1043788

Allport, F. H. (1924). *Social psychology*. Boston, Houghton.

Alvarez León, L. F. (2018). Information policy and the spatial constitution of digital geographic information markets. *Economic Geography*, *94*(3), 217-237.

Amideo, A. E., Scaparra, M. P., & Kotiadis, K. (2019). Optimising shelter location and evacuation routing operations: The critical issues. *European Journal of Operational Research*, *279*(2), 279-295.

Anderson, J., Casas Saez, G., Anderson, K., Palen, L., & Morss, R. (2019). Incorporating context and location into social media analysis: A scalable, cloud-based approach for more powerful data science.

Aradau, C. (2015). 'Crowded places are everywhere we go': Crowds, emergency, politics. *Theory, Culture & Society*, *32*(2), 155-175. https://doi.org/10.1177/0263276414562429

Bagozzi, R. P. (2007). The legacy of the technology acceptance model and a proposal for a paradigm shift. *Journal of the association for information systems*, *8*(4), 3. http://aisel.aisnet.org/jais/vol8/iss4/3

Balata, J. (2018). *Verbal Route Descriptions in Navigation of People with Visual Impairments* (Order No. 29118684). Available from ProQuest Dissertations & Theses Global. (2675219648). https://jerome.stjohns.edu/login?url=https://www.proquest.com/dissertations-theses/verbal-route-descriptions-navigation-people-with/docview/2675219648/se-2

Ballantyne, J., Ballantyne, R., & Packer, J. (2014). Designing and managing music festival experiences to enhance attendees' psychological and social benefits. *Musicae scientiae*, *18*(1), 65-83.

Bandura, A. (1978). The self system in reciprocal determinism. *American psychologist*, *33*(4), 344.

Barr, D., Drury, J., & Choudhury, S. (2022). Understanding collective flight responses to (mis) perceived hostile threats in Britain 2010-2019: a systematic review of ten years of false alarms in crowded spaces. *Journal of Risk Research*, 1-19.

Bartlett, F. (1932). *A study in experimental and social psychology.* New York: Cambridge University Press.

Batson, C. D. (2010). Empathy-induced altruistic motivation. In M. Mikulincer & P. R. Shaver (Eds.), *Prosocial motives, emotions, and behavior: The better angels of our nature* (pp. 15–34). Washington, DC: American Psychological Association.

Baumeister, R. F., & Leary, M. R. (1995). The need to belong: desire for interpersonal attachments as a fundamental human motivation. Psychological bulletin, 117(3), 497.

Belkhouja, T., & Doppa, J. (2020). Analyzing Deep Learning for Time-Series Data Through Adversarial Lens in Mobile and IoT Applications. IEEE Transactions on Computer-Aided Design of Integrated Circuits And Systems, 39(11), 3190-3201. doi:10.1109/tcad.2020.3012171

Bentley, S. V., Greenaway, K. H., Haslam, S. A., Cruwys, T., Steffens, N. K., Haslam, C., & Cull, B. (2020). Social identity mapping online. *Journal of personality and social psychology*, *118*(2), 213. doi.org/10.1037/pspa0000174

Berg, S. (2006). Snowball sampling 1- Sequential estimation of the mean in finite population to Steiner's most frequent value. Encyclopedia of Statistical Sciences, 12. Doi: 10.1002/0471667196.ess2478.pub2

Berger, J., Bayarri, M. J., & Pericchi, L. R. (2013). The effective sample size. *Economic Reviews, 33*(1-4), 197-217. doi:10.1080/07474938.2013.807157

Best, E. (2013). Incorporating groups, collective behaviors, and information visualization in agent-based models of evacuation. https://udspace.udel.edu/handle/19716/27840

Bica, M., Weinberg, J., & Palen, L. (2020). Achieving accuracy through ambiguity: The interactivity of risk communication in severe weather events. *Computer Supported Cooperative Work (CSCW)*, *29*(5), 587-623. https://doi.org/10.1007/s10606-020-09380-2

Bieri, J. (1955). Cognitive complexity-simplicity and predictive behavior. J. Abnorm. Soc. Psychol. 51, 263. doi: 10.1037/h0043308

Blanke, U., Tröster, G., Franke, T., & Lukowicz, P. (2014, April). Capturing crowd dynamics at large scale events using participatory GPS-localization. In *2014 IEEE Ninth International Conference on Intelligent Sensors, Sensor Networks and Information Processing (ISSNIP)* (pp. 1-7). IEEE.

Bode, N., & Codling, E. (2013). Human exit route choice in virtual crowd evacuations, Animal Behavior, Volume 86, Issue 2, 2013, Pages 347-358, https://doi.org/10.1016/j.anbehav.2013.05.025.

Borges, A. P., Cunha, C., & Lopes, J. (2021). The main factors that determine the intention to revisit a music festival. *Journal of Policy Research in Tourism, Leisure and Events*, *13*(3), 314-335.

Bollen, K. A. (2002). Latent variables in psychology and the social sciences. *Annual review of psychology*, *53*(1), 605-634.

Borowski, E., & Stathopoulos, A. (2020). On-demand ridesourcing for urban emergency evacuation events: An exploration of message content, emotionality, and intersectionality. *International Journal of Disaster Risk Reduction*, *44*, [101406]. https://doi.org/10.1016/j.ijdrr.2019.101406

Bows, H., King, H., & Measham, F. (2022). Perceptions of safety and experiences of gender-based violence at UK music festivals. *Journal of Gender-Based Violence*, *1*(aop), 1-19. https://doi.org/10.1332/239868021X16439111624553

Burke, J. A., Estrin, D., Hansen, M., Parker, A., Ramanathan, N., Reddy, S., & Srivastava, M. B. (2006). Participatory sensing.

Burnes B. (2020). The origins of Lewin's three-step model of change. *The Journal of Applied Behavioral Science*, 56(1), 32–59. https://doi.org/10.1177/0021886319892685

Burstedde C, Kirchner A, Klauck K, Schadschneider A, Zittartz J (2001). Cellular automaton approach to pedestrian dynamics—applications. Pedestrian and Evacuation Dynamics. Springer, Berlin, pp 87–97

Bracken, P. J., Bremmer, I., & Gordon, D. (Eds.). (2008). *Managing strategic surprise: Lessons from risk management and risk assessment*. Cambridge: Cambridge University Press.

Braddock, K. (2020). Weaponized Words. The Strategic Role of Persuasion in Violent Radicalization and Counter Radicalization. Cambridge University Press.

Brehm, J. W. (1966). *A theory of psychological reactance.* (New York: Academic Press).

Brey, P. (2014). The physical and social reality of virtual worlds. *The Oxford handbook of virtuality*, 42-54.

Bronfenbrenner, U. (1994). Ecological models of human development. In T. Husen & T. N. Postlethwaite (Eds.), International encyclopedia of education (2nd ed., Vol. 3, pp. 1643–1647). Oxford, England: Pergamon Press/Elsevier Science.

Brown, A. E., Donne, K., Fallon, P., & Sharpley, R. (2020). From headliners to hangovers: Digital media communication in the British rock music festival experience. *Tourist Studies*, *20*(1), 75-95.

Busselle, R. and Bilandzic, H. (2008). Fictionality and Perceived Realism in Experiencing Stories: A Model of Narrative Comprehension and Engagement, *Communication Theory* 18. 255-280.

Cambel, A. B. (1993). *Applied chaos theory: A paradigm for complexity*. Elsevier.

Cardone, G., Cirri, A., Corradi, A., Foschini, L., Ianniello R., and Montanari, R., (2014). "Crowdsensing in Urban Areas for City-Scale Mass Gathering Management: Geofencing and Activity Recognition," in *IEEE Sensors Journal*, vol. 14, no. 12, pp. 4185-4195. https://doi: 10.1109/JSEN.2014.2344023

Carroll, T. (2016). *Employee Perceptions of Biometric Security Adoption in the Workplace* (Order No. 10155668). Available from ProQuest Central; ProQuest Dissertations & Theses Global. (1836799110).

Cartwright, D., & Zander, A. (1968). Group dynamics.

Chalmers, D. J. (2017). The virtual and the real. *Disputatio: International Journal of Philosophy*, *9*(46).

Chamlee-Wright, E., & Storr, V. H. (2011). Social Capital as Collective Narratives and Post-Disaster Community Recovery. The Sociological Review, 59(2), 266–282. https://doi.org/10.1111/j.1467-954X.2011.02008.x

Chapman, K. R., Carmichael, F. J., & Goode, J. E. (1982). Medical services for outdoor rock music festivals. *Canadian Medical Association journal*, *126*(8), 935–938.https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1862986

Chiang, L., Xu, A., Kim, J., Tang, L., & Manthiou, A. (2017). Investigating festivals and events as social gatherings: the application of social identity theory. *Journal of Travel & Tourism Marketing*, *34*(6), 779-792.https://doi.org/10.1080/10548408.2016.1233927

Chu, M. L., Parigi, P., Latombe, J. C., & Law, K. H. (2014). Simulating effects of signage, groups, and crowds on emergent evacuation patterns. *Ai & Society*, *30*(4), 493-507.

Chuttur M.Y. (2009). "*Overview of the Technology Acceptance Model: Origins, Developments and Future Directions*," Indiana University, USA . *Sprouts: Working Papers on Information Systems*, 9(37). http://sprouts.aisnet.org/9-37

Cicek, D., & Kantarci, B. (2023). Use of Mobile Crowdsensing in Disaster Management: A Systematic Review, Challenges, and Open Issues. *Sensors*, *23*(3), 1699.

Cipresso, P. (2015). Modeling behavior dynamics using computational psychometrics within virtual worlds. Frontiers in psychology, 6, 1725.

Cocking, C., Drury, J., Reicher, S. (2009). The psychology of crowd behavior in emergency evacuations: Results from two interview studies and implications for the Fire and Rescue Services. Irish Journal of Psychology, 30, pp. 59-73.

Cocking, C. (2013). Crowd flight in response to police dispersal techniques: a momentary lapse of reason?. *Journal of investigative psychology and offender profiling*, *10*(2), 219-236.

Cohen, J. (1988). Statistical power analysis for the behavioral sciences (2nd ed.). Hillside, NJ: Lawrence Erlbaum Associates.

Colucci F. P., Colombo M. (2018). Dewey and Lewin: A neglected relationship and its current relevance to psychology. *Theory & Psychology*, 28(1), 20–37. https://doi.org/10.1177/0959354317740229

Coombs, W. T. (2021). *Ongoing crisis communication: Planning, managing, and responding*. Sage Publications.

Coombs, W.T. & Holladay, S. (2012). The Handbook of Crisis Communication. Blackwell Publishing Inc.

Cornwell, B. (2003). Bonded fatalities: Relational and ecological dimensions of a fire evacuation. *The Sociological Quarterly*, 44, 617–638.

Cousineau, L., Oakes, H., & Johnson, C. (2018). Appnography: Modifying Ethnography for App-Based Culture. Digital Dilemmas, 95-117. doi: 10.1007/978- 3-319-95300-7_5

Creswell, J. W., & Poth, C. N. (2017). *Qualitative inquiry and research design: Choosing among five traditions* (4th ed.). Thousand Oaks, CA: Sage Publications.

Croom, A. M. (2015). Music practice and participation for psychological well-being: A review of how music influences positive emotion, engagement, relationships, meaning, and accomplishment. *Musicae Scientiae*, *19*(1), 44–64. https://doi.org/10.1177/1029864914561709

Cruwys, T., Steffens, N. K., Haslam, S. A., Haslam, C., Jetten, J., & Dingle, G. A. (2016). Social Identity Mapping: A procedure for visual representation and assessment of subjective multiple group memberships. *British Journal of Social Psychology*, *55*(4), 613-642. https://doi.org/10.1111/bjso.12155

Cudny, W. (2014). The phenomenon of festivals: Their origins, evolution, and classifications. *Anthropos*, (H. 2), 640-656.

Davis, F. D. (1989). Perceived usefulness, perceived ease of use, and user acceptance of information technology. *MIS Quarterly*, *13*(3), 319–340. doi:10.2307/249008

Davis, F. D., Bagozzi, R. P., & Warshaw, P. R. (1989). User acceptance of computer technology: A comparison of two theoretical models. *Management science*, *35*(8), 982-1003. https://doi.org/10.1287/mnsc.35.8.982

De Geus S. D., Richards G., Toepoel V. (2016) 'Conceptualisation and Operationalisation of Event and Festival Experiences: Creation of an Event Experience Scale', *Scandinavian Journal of Hospitality and Tourism* 16(3): 274–96.

De Vries, P., Galetzka, M., & Gutteling, J. (2014). Persuasion in the wild: Communication, technology, and event safety. In *Persuasive Technology: 9th International Conference, PERSUASIVE 2014, Padua, Italy, May 21-23, 2014. Proceedings 9* (pp. 80-91). Springer International Publishing. https://doi.org/10.1007/978-3-319-07127-5_8

Denzin, N. K., & Lincoln, Y. S. (2008). *Collecting and Interpreting Qualitative Materials* (Vol. 3). Sage.

Determe, J.F., Azzagnuni, S., Singh, U., Horlin F., and Doncker, D. (2022). "Monitoring Large Crowds with WiFi: A Privacy-Preserving Approach," in *IEEE Systems Journal*, vol. 16, no. 2, pp. 2148-2159. doi:10.1109/JSYST.2021.3139756

Ding, Q., Wang, Y. M., & Goh, M. (2021). An extended TODIM approach for group emergency decision making based on bidirectional projection with hesitant triangular fuzzy sets. *Computers & Industrial Engineering*, *151*, https://doi.org/10.1016/j.cie.2020.106959

Duives D.C., Daamen W., & Hoogendoorn S. (2014) Trajectory Analysis of Pedestrian Crowd Movements at a Dutch Music Festival. In: Weidmann U., Kirsch U., Schreckenberg M. (eds) Pedestrian and Evacuation Dynamics 2012. Springer, Cham. https://doi.org/10.1007/978-3-319-02447-9_11

Drabek, T. E. (2018). *The human side of disaster*. CRC Press.

Draxler, F., Brenner, J. M., Eska, M., Schmidt, A., & Chuang, L. L. (2022, March). Agenda-and Activity-Based Triggers for Microlearning. In *27th International Conference on Intelligent User Interfaces* (pp. 620-632).

Drury, J. (2003). Social identity as a source of strength in mass emergencies and other crowd events. *International Journal of Mental Health*, *32*(4), 77-93. https://doi.org/10.1080/00207411.2003.11449599

Drury, J. (2011). Collective resilience in mass emergencies and disasters: A social identity model. In J. Jetten, C. Haslam, & S. A. Haslam (Eds.), The social cure: Identity, health, and well-being (pp. 195-215). Hove, UK: Psychology Press.

Drury, J. (2018) The role of social identity processes in mass emergency behaviour: An integrative review, European Review of Social Psychology, 29:1, 38-81, DOI: 10.1080/10463283.2018.1471948

Drury, J., & Alfadhli, K. (2019). Social identity, emergencies and disasters. In R. Williams, S. Bailey, B. Kamaldeep, S. A. Haslam, C. Haslam, V. Kemp, & D. Maughan (Eds). *Social scaffolding: Applying the lessons of contemporary social science to health, public mental health and healthcare*. London: Royal College of Psychiatrists.

Drury, J., Carter, H., Cocking, C., Ntontis, E., Tekin Guven, S., & Amlôt, R. (2019). Facilitating collective psychosocial resilience in the public in emergencies: Twelve recommendations based on the social identity approach. *Frontiers in public health*, *7*, 141. https://doi.org/10.3389/fpubh.2019.00141

Drury, J., Cocking, C., Reicher, S., (2009a). Everyone for themselves? a comparative study of crowd solidarity among emergency survivors. British Journal of Social Psychology 28, 487–506.

Drury, J., Cocking, C., Reicher, S., (2009b). The nature of collective resilience: Survivor reactions to the 2005 London bombings. International Journal of Mass Emergencies and Disasters 27, 66–9

Drury, J., Novelli, D., & Stott, C. (2013). Representing crowd behaviour in emergency planning guidance: 'mass panic' or collective resilience? Resilience: International Policies, Practices and Discourses, 1:1, 18-37, DOI: 10.1080/21693293.2013.76570

Dusek, G., Yurova, Y., & Ruppel, C. P. (2015). Using social media and targeted snowball sampling to survey a hard-to-reach population: A case study. *International Journal of doctoral studies*, *10*, 279.

Dwivedi, Y. K., Rana, N. P., Jeyaraj, A., Clement, M., & Williams, M. D. (2019). Re-examining the unified theory of acceptance and use of technology (UTAUT): Towards a revised theoretical model. *Information Systems Frontiers*, *21*, 719-734.

Earl, C., Parker, E., Edwards, M., & Capra, M. (2005). Volunteers in public health and emergency management at outdoor music festivals (Part 2): A European study. *Australian Journal of Emergency Management, The*, *20*(1), 31-37.

Elangovan, N., & Sundaravel, E. (2021). Method of preparing a document for survey instrument validation by experts. *MethodsX*, *8*, https://doi.org/10.1016/j.mex.2021.101326

Elzie, T. L. (2022). Pedestrian Evacuation: Vulnerable Group Member Influence on the Group Leaders' Decision-Making and the Impact on Evacuation Time (Order No. 29206207). [Doctoral dissertation, Old Dominion University, Virginia] Available from ProQuest Dissertations & Theses Global. (2681870184). https://jerome.stjohns.edu/login?url=https://www.proquest.com/dissertations-theses/pedestrian-evacuation-vulnerable-group-member/docview/2681870184/se-2

Ellis, D. G., & Fisher, B. A. (1994). *Small group decision making: Communication and the group process*. New York, NY: McGraw-Hill.

Erikson, E. H. (1968). *Identity: Youth and crisis* (No. 7). WW Norton & company.

Eriksson, M. (2018). Lessons for crisis communication on social media: A systematic review of what research tells the practice. International Journal of Strategic Communication, 12(5), 526-551.https://doi.org/10.1080/1553118X.2018.1510405

Eroglu, S. A., Machleit, K., & Barr, T. F. (2005). Perceived retail crowding and shopping satisfaction: The role of shopping values. *Journal of Business Research*, 58(8), 1146–1153.https://doi.org/10.1016/j.jbusres.2004.01.005

Fahy, R. F., Proulx, G., & Aiman, L. (2011). Panic or not in fire: Clarifying the misconception. *Fire and materials*, *36*(5-6), 328-338.

Falassi, A. (1987). Festival: Definition and morphology. *Time out of Time: Essays on the Festival*, *1*.

Felmlee, D., Faris, R. (2013). Interaction in Social Networks. In: DeLamater, J., Ward, A. (eds) Handbook of Social Psychology. Handbooks of Sociology and Social Research. Springer, Dordrecht. https://doi.org/10.1007/978-94-007-6772-0_15

FEMA, (2018). 1 October After-Action Report. https://www.hsdl.org/?view&did=814668

Felt, A., Hay, E., Egelman, S., Haneyy, A., Chin, E., and Wagner, D. (2012). "Android Permissions: User Attention, Comprehension, and Behavior," in Symposium on Usable Privacy and Security 2012: Washington, DC, USA

Feinberg, W. E., & Johnson, N. R. (2001). Primary group size and fatality risk in a fire disaster. *Human behavior in fire: Understanding human behavior for better fire safety design*, 11-22.

Field, A. (2018). Discovering statistics using IBM SPSS statistics. SAGE Publications.

Fiske, S., & Taylor, S.E. (1991). Social Cognition (2nd Ed). New York: McGraw-Hill.

Franz, A., & Benlian, A. (2022). Exploring interdependent privacy – Empirical insights into users' protection of others' privacy on online platforms. *Electron Markets*. https://doi.org/10.1007/s12525-022-00566-8

Fruin, J. J. (1987). Pedestrian Planning and Design, revised edition. *Elevator World, Inc., Mobile, AL*.

Garay, L., & Morales Pérez, S. (2017). "Understanding the creation of destination images through a festival's Twitter conversation", *International Journal of Event and Festival Management*, Vol. 8 No. 1, pp. 39-54. https://doi.org/10.1108/IJEFM-04-2016-0030

Gärling, T., Böök, A., & Lindberg, E. (1986). Spatial orientation and wayfinding in the designed environment: A conceptual analysis and some suggestions for postoccupancy evaluation. *Journal of architectural and planning research*, 55-64.

George Washington University, (2021). "*This is our House*" A preliminary Assessment of the Capitol Hill Siege Participants. Program on Extremism. https://extremism.gwu.edu/sites/g/files/zaxdzs2191/f/This-Is-Our-House.pdf

Getz, D. (2000). Developing a research agenda for the event management field. In J. Allen, R. Harris, L. K. Jago, & A. J. Veal (Eds.), *Events beyond 2000: Setting the agenda – Proceedings of Conference on Event Evaluation, Research and Education* (pp. 10–21). Sydney: Australian Centre for Event Management, University of Technology.

Getz, D. (2008). Event tourism: Definition, evolution, and research. *Tourism Management.* Vol 29. Issue 3. pp. 403 - 428. https://doi.org/10.1016/j.tourman.2007.07.017

Ghosh, I., & Singh, V. (2022). "Not all my friends are friends": Audience-group-based nudges for managing location privacy. *Journal of the Association for Information Science and Technology*, *73*(6), 797-810.

Gibson, C. & Connell, J. (2005) Music and tourism. Great Britain: The Cromwell Press.

Girvan, C. (2018). What is a virtual world? Definition and classification. Educational Technology Research and Development, 66(5), 1087-1100.

Gist, R. & Lubin, B., (1999). Response to Disaster; Psychological Community and Ecological Approaches. Taylor & Francis.

Goltz, J. D. (1984). Are the news media responsible for the disaster myths? A content analysis of emergency response imagery. International Journal of Mass Emergencies and Disasters, 2, 345–368.

González-Herrero, & Smith, (2008). Crisis Communications Management on the Web: How Internet-Based Technologies are Changing the Way Public Relations Professionals Handle Business Crises. Vol. 16 Issue 3. Pp. 143 - 153 https://doi.org/10.1111/j.1468-5973.2008.00543.x

Granovetter, M. S. (1973). The strength of weak ties. *American journal of sociology*, *78*(6), 1360-1380.

Grunig, J. E. (1976). Organizations and Public Relations: Testing a Communication Theory.

Gunawardena, C. N., & Zittle, F. J. (1997). Social presence as a predictor of satisfaction within a computer-mediated conferencing environment. *American journal of distance education*, *11*(3), 8-26. https://doi.org/10.1080/08923649709526970

Gunnell, D. O. A., Kunar, M. A., Richards, R. H., & Watson, D. G. (2022). Telephone conversations affect the executive but not the alerting or orienting network. Journal of Experimental Psychology: Applied, 28(2), 249-261. https://doi.org/10.1037/xap0000435

Guthrie, E. (2020). Bomb threats and bag checks: model legislation to address venue safety and liability. Belmont Law Review, 7(2), 440-471.

Guyon H., Kop J.-L., Juhel J., Falissard B. (2018). Measurement, ontology, and epistemology: Psychology needs pragmatism-realism. *Theory & Psychology*, 28(2), 149–171. https://doi.org/10.1177/0959354318761606

Haas, J. P. (2012). Sample size and power. *American Journal of Infection Control, 40*(8), 766-767. https://doi:10.1016/j.ajic.2012.05.020

Hagar, C. (2015). Crisis informatics. In *Encyclopedia of Information Science and Technology, Third Edition* (pp. 1350-1358). IGI Global.

Haghani, M. (2021). The knowledge domain of crowd dynamics: Anatomy of the field, pioneering studies, temporal trends, influential entities and outside-domain impact *Physica A: Statistical Mechanics and its Applications*, *580*, 126145.

Haghani, M., Cristiani, E., Bode, N., Boltes, M., & Corbetta, A. (2019). Panic, Irrationality, and Herding: Three Ambiguous Terms in Crowd Dynamics Research. Journal of Advanced Transportation. https://doi.org/10.1155/2019/9267643

Haghani, M., and Sarvi, (2016). Human exit choice in crowded built environments: Investigating underlying behavioral differences between normal egress and emergency evacuations, Fire Safety Journal, Volume 85, Pages 1-9, https://doi.org/10.1016/j.firesaf.2016.07.003.

Haghani & Sarvi (2018). Crowd behavior and motion: Empirical methods; Transportation Research Part B: Methodological, Volume 107, 2018, Pages 253-294,https://doi.org/10.1016/j.trb.2017.06.017.

Hargreaves, D., Miell, D., MacDonald, R. (2002). What are musical identities and why are they important? In MacDonald, R., Hargreaves, D. (Eds.), Musical identities (pp. 1–20). Oxford, UK: Oxford University Press.

Harris, M. A., Brookshire, R., Patten, K., & Regan, B. (2015). Mobile application installation influences: have mobile device users become desensitized to excessive permission requests. In *Proceedings of the Twentieth Americas Conference on Information Systems (AMCIS 2015)* (pp. 13-15).

Hearit, K.M. (1995). "Mistakes were Made": Organizations, apologia, and crises of social legitimacy. Communications Studies, 46(1-2): 1 - 17.

Helbing, D., & Mukerji, P. (2012). Crowd disasters as systemic failures: analysis of the Love Parade disaster. EPJ Data Science, 1, 1-40.

Hinkin, T. R., Tracey, J. B., & Enz, C. A. (1997). Scale construction: Developing reliable and valid measurement instruments. *Journal of Hospitality & Tourism Research*, *21*(1), 100-120.

Hintze, M. (2016). Privacy Statements: Purposes, Requirements, and Best Practices. *Cambridge Handbook of Consumer Privacy, Jules Polonetsky, Evan Selinger & Omer Tene, eds., Cambridge University Press (2018)*.

Ho, G., Stephens, G., & Jamieson, R. (2003). Biometric authentication adoption issues.

Homans, G. C. (2013). *The human group*. Routledge.

Hoover, K. C., Crampton, J. W., Smith, H., & Berbesque, J. C. (2022). Surveillance, trust, and policing at music festivals. *The Canadian Geographer/Le Géographe canadien*, *66*(2), 202-219.

Hogg, M.A. (2016). Social Identity Theory. In: McKeown, S., Haji, R., Ferguson, N. (eds) Understanding Peace and Conflict Through Social Identity Theory. Peace Psychology Book Series. Springer, Cham. https://doi.org/10.1007/978-3-319-29869-6_1

Hoksbergen, E., & Insch, A. (2016). Facebook as a platform for co-creating music festival experiences: The case of New Zealand's rhythm and vines New Year's Eve festival. *International Journal of Event and Festival Management.* Vol. 7 No. 2, pp. 84-99. https://doi.org/10.1108/IJEFM-02-2016-0012

Houston, J. B., Hawthorne, J., Perreault, M. F., Park, E. H., Goldstein Hode, M., Halliwell, M. R., ... & Griffith, S. A. (2015). Social media and disasters: a functional framework for social media use in disaster planning, response, and research. *Disasters*, *39*(1), 1-22. https://doi.org/10.1111/disa.12092

Hsiao, C., Chang, J., & Tang, K. (2016). Exploring the influential factors in continuance usage of mobile social Apps: Satisfaction, habit, and customer value perspectives. *Telematics and Informatics*, *33*(2), 342–355.

Hsu, C., & Lin, J. (2008). Acceptance of blog usage: The roles of technology acceptance, social influence and knowledge sharing motivation. *Information & Management*, 45(1), 65–74. *doi:10.1016/j.im.2007.11.001*

Hsu, H. H., & Chang, Y. Y. (2013). Extended TAM model: Impacts of convenience on acceptance and use of moodle. *US-China Education Review A*, *3*(4), 211–218.

Hudson, S. & Hudson, R., (2013). Engaging with consumers using social media: a case study of music festivals. Int J Event Festival Management 4:206–223

Hughes, E. A., Ellis, S., & Smith, J. R. (2023). Connecting groups and behaviours: A network analysis of identity-infused behaviours. *British Journal of Social Psychology*. https://doi.org/10.1111/bjso.12674

Husman, M. A., Albattah, W., Abidin, Z. Z., Mustafah, Y. M., Kadir, K., Habib, S., ... & Khan, S. (2021). Unmanned aerial vehicles for crowd monitoring and analysis. Electronics, 10(23), 2974. https://doi.org/10.3390/electronics10232974

Imran, M., Castillo, C., Diaz, F., & Vieweg, S. (2015). Processing social media messages in mass emergency: A survey. *ACM Computing Surveys (CSUR)*, *47*(4), 1-38. https://doi.org/10.1145/2771588

Jaensch, J., Whitehead, D., Prichard, I., & Hutton, A. (2018). Exploring young peoples' use of alcohol at outdoor music festivals in Australia. Journal of Applied Youth

Studies, 2(3), 32–42. *https://search.informit.org/doi/10.3316/informit.431681436145440*

Jensen, L. (2003). Coming of age in a multicultural world: Globalization and adolescent cultural identity formation. Applied Developmental Science, 7(3), 189-196. https://doi.org/10.1207/S1532480XADS0703_10

Johnson, N. R. (1987). Panic at "The Who Concert Stampede": An Empirical Assessment. *Social Problems*, *34*(4), 362–373. https://doi.org/10.2307/800813

Johnson, N. R., & Feinberg, W. E. (1977). A Computer Simulation of the Emergence of Consensus in Crowds. *American Sociological Review*, *42*(3), 505–521. https://doi.org/10.2307/2094754

Jong, W., & Brataas, K. (2021). Victims as stakeholders: insights from the intersection of psychosocial, ethical, and crisis communication paths. *Journal of International Crisis and Risk Communication Research*, *4*(1), 73-92.

Kadushin, C. (2002). The motivational foundation of social networks. *Social networks*, *24*(1), 77-91.

Kamel Boulos, M. N., Resch, B., Crowley, D. N., Breslin, J. G., Sohn, G., Burtner, R., ... & Chuang, K. Y. S. (2011). Crowdsourcing, citizen sensing and sensor web technologies for public and environmental health surveillance and crisis management: trends, OGC standards and application examples. *International journal of health geographics*, *10*(1), 1-29.

Kaufhold, MA. (2021). Design and Evaluation of a Mobile Crisis App. In: Information RefinementTechnologies for Crisis Informatics. Springer Vieweg, Wiesbaden. https://doi.org/10.1007/978-3-658-33341-6_11

Kaul, M. (2017). Privacy: A Price paid for Technology. *Ct. Uncourt*, *4*, 2.

Khalaf, S. (2015). Seven years into the mobile revolution: Content is king… again. Yahoo Developer Network.

Khan, F., Rehman, A. U., Zheng, J., Jan, M. A., & Alam, M. (2019). Mobile crowdsensing: A survey on privacy-preservation, task management, assignment models, and incentives mechanisms. *Future Generation Computer Systems*, *100*, 456-472.

Kihlstrom, J. F. (2013). The person-situation interaction. In D. E. Carlston (Ed.), Oxford library of psychology. The Oxford handbook of social cognition (p. 786–805). Oxford University Press.

Kim, S., Yoon, D., & Han, E. (2016). Antecedents of mobile app usage among smartphone users. *Journal of Marketing Communications*, *22*(6), 653–670. doi:10.1080/13527266.2014.951065

Knijnenburg, B. P., Page, X., Wisniewski, P., Lipford, H. R., Proferes, N., & Romano, J. (2022). Modern Socio-Technical Perspectives on Privacy.

Konomi, S., & Sasao, T. (2016). Crowd Geofencing, Proceedings of the Second International Conference on IoT in Urban Space; Pages 14–17; https://doi.org/10.1145/2962735.2962744

Krumm, J. S. (2013). *Influence of social media on crowd behavior and the operational environment*. Army Command & General Staff College Fort Leavenworth KS, School of Advanced Military Studies.

Le Bon, G. (1895) The Crowd: A Study of the Popular Mind. Transaction, London.

Leaper, (2011). More Similarities than Differences in contemporary Theories of social development? A plea for theory bridging. (eds) Advances in Child Development Behavior vol 40. pps. 337-378. https://doi.org/10.1016/B978-0-12-386491-8.00009-8

Lee, H., Hong, S., Kim, B., & MacPherson, J. (2022). How does it depend?: A systematic review of the contingency theory of accommodation in communication scholarship. *Public Relations Review*, *48*(1), 102148.

Lehdonvirta, V. (2010). Virtual worlds don't exist: Questioning the dichotomous approach in MMO studies. The International Journal of Computer Game Research, 10(1)

Lemay, D.J., Dolek, T., & Bazelais, P. (2017). "Passion and concern for privacy" as factors affecting snapchat use: A situated perspective on technology acceptance. *The Journal of Computers and Human Behavior.* Vol. 75, pp. 264-271. https://doi.org/10.1016/j.chb.2017.05.022

Leszczynski, A. (2019). Platform affects of geolocation. *Geoforum* 107: 207–215. https://doi.org/10.1016/j.geoforum.2019.05.01

Levine, M., & Manning, R. (2013). Social identity, group processes, and helping in emergencies. *European Review of Social Psychology*, *24*(1), 225-251.

Lewin, K. (1936). Principles of topological psychology. New York, NY: McGraw-Hill.

Li, M., Xu, J., Liu, X., Sun, C., and Duan, Z. (2018). Use of Shared-Mobility Services to Accomplish Emergency Evacuation in Urban Areas via Reduction in Intermediate Trips—Case Study in Xi'an, China. Sustainability. 10(12):4862. https://doi.org/10.3390/su10124862

Li, X., & Xie, X. (2017). The helping behavior helps lighten physical burden. *Basic and Applied Social Psychology*, *39*(4), 183-192.

Lickel, B., Hamilton, D. L., Wieczorkowska, G., Lewis, A., Sherman, S. J., & Uhles, A. N. (2000). Varieties of groups and the perception of group entitativity. *Journal of personality and social psychology*, *78*(2), 223.

Luxford, A., & Dickinson, J.E., (2015). The Role of Mobile Applications in the Consumer Experience at Music Festivals; Event Management, Volume 19, Number 1, 2015, pp. 33-46(14). https://doi.org/10.3727/152599515X14229071392909

Ma, J., Song, W. G., Lo, S. M., & Fang, Z. M. (2013). New insights into turbulent pedestrian movement pattern in crowd-quakes. *Journal of Statistical Mechanics: Theory and Experiment*, *2013*(02), P02028.

Mao, Y., Fan, Z., Zhao, J., Zhang, Q., & He, W. (2019). An emotional contagion-based simulation for emergency evacuation peer behavior decision. *Simulation Modelling Practice and Theory*, *96*, https://doi.org/10.1016/j.simpat.2019.101936

MacCarthy, M., Morgan, A. and Lambert, C. (2022), "Congregating as a social phenomenon; the social glue that binds", *International Journal of Event and Festival Management*, Vol. 13 No. 2, pp. 235-246. https://doi.org/10.1108/IJEFM-11-2021-0085

MacKay PhD, K., Van Winkle PhD, C., Halpenny PhD, E., & Barbe, D. (2016). Social Media Use in Festival and Daily Life Contexts.

MacKay, K., Van Winkle, C., & Halpenny, E. (2019). Active vs passive social media use, attendee engagement, and festival loyalty.

Mahdi, F., Zeinab, G., & Mansourian, A. (2020). Dynamic Spatio-temporal tweet mining for event detection: A Case Study of Hurricane Florence. Int. J. Disaster Risk Sci., 11 pp. 378-393.

Makawana, P. R., Joshi, S., Katira, A., Bharvad, J., & Pawar, C. (2022). A Bibliometric Analysis of Recent Research on Delay-Tolerant Networks. *ICT Systems and Sustainability*, 247-256.

Martinez, F.J., Toh, C., Cano, J., Calafate, C., & Manzoni, P. (2010). "Emergency Services in Future Intelligent Transportation Systems Based on Vehicular Communication Networks," in *IEEE Intelligent Transportation Systems Magazine*, vol. 2, no. 2, pp. 6-20, doi: 10.1109/MITS.2010.938166

Mawson, A. R. (2005). Understanding mass panic and other collective responses to threat and disaster. *Psychiatry*, *68*(2), 95-113.

McCreery, M. P., Krach, S. K., Schrader, P. G., & Boone, R. (2012). Defining the virtual self: Personality, behavior, and the psychology of embodiment. *Computers in Human Behavior*, *28*(3), 976-983.

McDougall, W. (1920). The Group Mind. New York: G.P. Putnam's Sons

McKay, G. (Ed.). (2015). *The pop festival: history, music, media, culture*. Bloomsbury Publishing USA.

Merriam, S. B., & Tisdell, E. J. (2016). *Qualitative Research: A Guide to Design and Implementation*. John Wiley & Sons.

Mintz, A. (1951). Non-adaptive group behavior. The Journal of Abnormal and Social Psychology, 46(2), 150–159. https://doi.org/10.1037/h0063293

Mitcham, D., Taylor, M., & Harris, C. (2021). Utilizing Social Media for Information Dispersal during Local Disasters: The Communication Hub Framework for Local Emergency Management. *International Journal of Environmental Research and Public Health*, *18*(20), https://doi.org/10.3390/ijerph182010784

Mitchell, P., Foth, M., & Anastasiu, I. (2021). Geographies of locative apps. In *Routledge Handbook of Media Geographies* (pp. 183-195). Routledge.

Moody, J., & White, D. R. (2003). Structural cohesion and embeddedness: A hierarchical concept of social groups. American sociological review, 103-127.

Moore, M. (2020). Safe LA. Civil Unrest 2020. After-Action Report. https://lapdonlinestrgeacc.blob.core.usgovcloudapi.net/lapdonlinemedia/2021/11/BPC_21-066.pdf

Moore, S. C., Flajšlik, M., Rosin, P. L., & Marshall, D. (2008). A particle model of crowd behavior: Exploring the relationship between alcohol, crowd dynamics and violence. Aggression and violent behavior, 13(6), 413-422. https://doi.org/10.1016/j.avb.2008.06.004

Mules, T. (2004). Case study: Evolution in event management: The Gold Coast's Wintersun Festival. Event Management, 9 (1/2), 95-101.

Mylonas, A., Kastania, A., & Gritzalis, D. (2013). "Delegate the smartphone user? Security awareness in smartphone platforms," Computers & Security (34:0), pp. 47-66.

Naoum-Sawaya, J. & Yu, J. (2017). Ridesharing for emergency evacuation. INFOR: Information Systems and Operational Research. 55. 1-20. http://dx.doi.org/10.1080/03155986.2017.1302773

Narayanan, M., & Arun, C. (2014). An efficient technique for video content managing in Peer-to-Peer computing using multilevel cache and bandwidth based cluster. In *2014 International Conference on Signal Propagation and Computer Technology (ICSPCT 2014)* (pp. 317-322). IEEE.

Nass, C., Moon, Y., Fogg, B. J., Reeves, B., & Dryer, C. (1995, May). Can computer personalities be human personalities?. In *Conference companion on Human factors in computing systems* (pp. 228-229).

Neville, F.G., Novelli, D., Drury, J., & Reicher, S. D. (2022). Shared social identity transforms social relations in imaginary crowds. *Group Processes & Intergroup Relations*, *25*(1), 158-173.

Neville, F.G., & Reicher, S.D. (2011). The experience of collective participation: Shared identity, relatedness and emotionality. Contemporary social science, 6(3), 377-396. https://doi.org/10.1080/21582041.2012.627277

Neville, F.G. & Reicher, S.D. (2018). Crowds, Social Identities, and the Shaping of Everyday Social Relations. In Political Psychology (eds C.J. Hewer and E. Lyons). https://doi.org/10.1002/9781118982365.ch12

Ngoc-Anh T., Nguyen, Zucker, J.D., Nguyen, H.D., Drogoul, A., & Duc An Vo. (2011). A Hybrid macro-micro pedestrians evacuation model to speed up simulation in road networks. AAMAS, Taipei, Taiwan. ⟨10.1007/978-3-642-27216-5_28⟩.

Nissenbaum, H. (2009). Privacy in context. In *Privacy in Context*. Stanford University Press.

Norberg, P. A., Horne, D. R., & Horne, D. A. (2007). The privacy paradox: Personal information disclosure intentions versus behaviors. *Journal of Consumer Affairs*, *41*(1), 100–126. https://doi: 10.1111/j.1745-6606.2006.00070.x

Norfolk, L., & O' Regan, M., (2020). Biometric technologies at music festivals: An extended technology acceptance model. Journal of Convention & Event Tourism. vol 22 Issue 1. https://doi:org.jerome.stjohns.edu/10.1080/15470148.2020.1811184

Norman, T., Peacock, A., Ferguson, S. G., Kuntsche, E., & Bruno, R. (2021). Combining transdermal and breath alcohol assessments, real-time drink logs and retrospective self-reports to measure alcohol consumption and intoxication across a multi-day music festival. *Drug and alcohol review*, *40*(7), 1112-1121.

O'Regan, M., & Chang, H. (2015). Smartphone adoption amongst Chinese youth during leisure-based tourism: Challenges and opportunities. *Journal of China Tourism Research*, *11*(3), 238-254. https://doi.org/10.1080/19388160.2015.1077181

Obar, J. A., & Oeldorf-Hirsch, A. (2020). The biggest lie on the internet: Ignoring the privacy policies and terms of service policies of social networking services. *Information, Communication & Society*, *23*(1), 128-147.

Offerman, T. (2002). Hurting hurts more than helping helps. *European Economic Review*, *46*(8), 1423-1437. https://doi.org/10.1016/S0014-2921(01)00176-3

Oh, H., Fiore, A. M., & Jeoung, M. (2007). Measuring experience economy concepts: Tourism applications. *Journal of Travel Research*, 46(2), 119–132.https://doi.org/10.1177%2F0047287507304039

Oh, O., Kwon, K. H., & Rao, H. R. (2010). An exploration of social media in extreme events: Rumor theory and Twitter during the Haiti earthquake 2010.https://aisel.aisnet.org/icis2010_submissions/231

Okřinová, P., Nikolov, D., & Uhlík, O. (2020). Optimization of the Evacuation of the Music Festival Grounds Using a Numerical Model. https://files.thunderheadeng.com/femtc/2020_d1-07-okrinova-paper.pdf

Ouyang, R. W., Srivastava, A., Prabahar, P., Roy Choudhury, R., Addicott, M., & McClernon, F. J. (2013, September). If you see something, swipe towards it: crowdsourced event localization using smartphones. In *Proceedings of the 2013 ACM international joint conference on Pervasive and ubiquitous computing* (pp. 23-32). https://doi.org/10.1145/2493432.2493455

Packer, J., & Ballantyne, J. (2011). The impact of music festival attendance on young people's psychological and social well-being. *Psychology of Music*, *39*(2), 164-181.

Palamar, J. J., & Sönmez, İ. (2022). A qualitative investigation exploring why dance festivals are risky environments for drug use and potential adverse outcomes. *Harm Reduction Journal, 19*, 1-13. https://doi.org/10.1186/s12954-022-00598-5

Palinkas, L. A., Horwitz, S. M., Green, C. A., Wisdom, J. P., Duan, N., & Hoagwood, K. (2015). Purposeful sampling for qualitative data collection and analysis in mixed method implementation research. *Administration and Policy in Mental Health and Mental Health Services Research, 42*(5), 533-544.

Parker, C., Scott, S., & Geddes, A. (2019). Snowball sampling. *SAGE research methods foundations*.

Patchen, T. (2015). 5 music festivals that rock at creating mobile experiences. https://www.linkedin. com/pulse/5-music-festivals-rock-creating-mobile-experiences-taylor-patchen

Pawelczak, P., Prasad, R.V., Xia, L., & Niemegeers, (2005). "Cognitive radio emergency networks - requirements and design," *First IEEE International Symposium on New Frontiers in Dynamic Spectrum Access Networks.* pp. 601-606. doi:10.1109/DYSPAN.2005.1542678

Perera, T., & Perera, T. (2021, April). Barrister-Processing and Summarization of Terms & Conditions/Privacy Policies. In *2021 6th International Conference for Convergence in Technology (I2CT)* (pp. 1-7). IEEE.

Petronio, S. (2002). Boundaries of privacy: Dialectics of disclosure. Suny Press.

Plangpramool, S. (2013). Perceptions of selected attributes in tourism management of music festivals: A case study of Pattaya Music Festival 2012. *Asia-Pacific Journal of Innovation in Hospitality and Tourism*, *2*(1), 53-67.

Ploder A. (2021). Kurt Lewin's wide-ranging influence on the history of qualitative research. In McElvenny J., Ploder A. (Eds.), *Holisms of communication: The early history of audio-visual sequence analysis* (pp. 63–68). Language Science Press.

Plotnick, L., & Hiltz, S. R. (2016). Barriers to use of social media by emergency managers. *Journal of Homeland Security and Emergency Management*, *13*(2), 247-277.

Preston N. W. (1979). Changing advice on vaccination. *British medical journal*, *1*(6157), 194–195. https://doi.org/10.1136/bmj.1.6157.194-c

Quarantelli E. L. (2001). The sociology of panic. In: Smelser NJ, Baltes PB, editors. *International Encyclopedia of the Social and Behavioural Sciences*. New York, NY: Pergamon Press (2001). p. 11020–23. https://udspace.udel.edu/handle/19716/308

Quarantelli, E. L. (2008). Conventional beliefs and counterintuitive realities. *Social Research: An International Quarterly*, *75*(3), 873-904.

Quarantelli, E. L., & Dynes, R. R. (1976). Organization Communications and Decision Making in Crises. http://udspace.udel.edu/handle/19716/1274

Quarantelli, E. L., & Dynes, R. R. (1977). Response to social crisis and disaster. *Annual review of sociology*, *3*(1), 23-49.http://udspace.udel.edu/handle/19716/4191

Ramesh, M. V., Shanmughan, A., & Prabha, R. (2014). Context aware ad hoc network for mitigation of crowd disasters. *Ad Hoc Networks*, *18*, 55-70. https://doi.org/10.1016/j.adhoc.2013.02.006

Ramsay, J. D., Cozine, K., & Comiskey, J. (Eds.). (2020). Theoretical Foundations of Homeland Security: Strategies, Operations, and Structures. Routledge.

Raphael, B. (2005) Crowds and Other Collectives: Complexities of Human Behaviors in Mass Emergencies, Psychiatry, 68:2, 115-120, DOI: 10.1521/psyc.2005.68.2.115

Reicher, S. (2011). Mass action and mundane reality: An argument for putting crowd analysis at the centre of the social sciences. Contemporary Social Science, 6(3), 433-449. https://doi.org/10.1080/21582041.2011.619347

Reicher, S., & Drury, J. (2011). Collective identity, political participation and the making of the social self. In Azzi, A., Chryssochoou, X. , Klandermans, B., & Simon, B. (), Identity and participation in culturally diverse societies: A multidisciplinary perspective (pp. 158–176). Oxford, England: Wiley-Blackwell.

Reid, S. E., Valasik, M., & Bagavathi, A. (2020). Examining the physical manifestation of alt-right gangs: From online trolling to street fighting. Gangs in the era of internet and social media, 105-134. https://doi.org/10.1007/978-3-030-47214-6_6

Reuter, C., Hughes, A. L., & Kaufhold, M.-A. (2018). Social media in crisis management: An evaluation and analysis of crisis informatics research. International Journal on Human-Computer Interaction. https://doi.org/10.1080/10447318.2018.1427832

Reuter, C., & Kaufhold, M. A. (2018). Fifteen years of social media in emergencies: a retrospective review and future directions for crisis informatics. Journal of contingencies and crisis management, 26(1), 41-57. https://doi.org/10.1111/1468-5973.12196

Reuter, C., Marx, A., & Pipek, V. (2012). Crisis management 2.0: Towards a systematization of social software use in crisis situations. International Journal of Information Systems for Crisis Response and Management (IJISCRAM), 4(1), 1-16. DOI: 10.4018/jiscrm.2012010101

Reykowski, J., & Smolenska, Z. (1980). Personality mechanisms of prosocial behavior. *Polish Psychological Bulletin*, *11*, 219–230

Riad, J. K., Norris, F. H., & Ruback, R. B. (1999). Predicting evacuation in two major disasters: Risk perception, social influence, and access to resources 1. *Journal of applied social Psychology*, *29*(5), 918-934. https://doi.org/10.1111/j.1559-1816.1999.tb00132.x

Robertson, R., and Combs, A. (2014). *Chaos Theory in Psychology and the Life Sciences.* London: Psychology Press.

Robertson, M., Yeoman, I., Smith, K.A., McMahon-Beattie, U. (2015). Technology, Society, and Visioning the Future of Music Festivals. Event Management, Volume 19, Number 4, 2015, pp. 567-587(21). https://doi.org/10.3727/152599515X14465748774001

Rogers, R. W. (1975). A protection motivation theory of fear appeals and attitude change. The Journal of Psychology. 1(91), 9-114. doi:10.1080/00223980.1975.9915803

Ronchi, E., Uriz, F. N., Criel, X., & Reilly, P. (2016). Modeling large-scale evacuation of music festivals. *Case Studies in Fire Safety*, *5*, 11-19. https://doi.org/10.1016/j.csfs.2015.12.002

Roy, S. (2017). App adoption and switching behavior: Applying the extended tam in smartphone app usage. *Journal of Information Systems and Technology Management*, *14*(2), 239–261. doi:10.4301/S1807-17752017000200006

Rubin, H. J., & Rubin, I. S. (2011). *Qualitative interviewing: The art of hearing data*. Sage.

Saadé, R., & Bahli, B. (2005). The impact of cognitive absorption on perceived usefulness and perceived ease of use in on-line learning: an extension of the technology acceptance model. *Information & management*, *42*(2), 317-327.

Saber Chtourou, M. and Souiden, N. (2010), "Rethinking the TAM model: time to consider fun", *Journal of Consumer Marketing*, Vol. 27 No. 4, pp. 336-344. https://doi-org.jerome.stjohns.edu/10.1108/07363761011052378

Sadri, A. M., Ukkusuri, S. V., & Ahmed, M. A. (2021). Review of social influence in crisis communications and evacuation decision-making. *Transportation research interdisciplinary perspectives*, *9*, https://doi.org/10.1016/j.trip.2021.100325

Sayed, H. (2014). *Location based asynchronous thread communications.* Patent Number: 8,682,349 B2. United States. https://www.google.com/url?q=https://patents.google.com/patent/US8682349B2/en&sa=D&source=docs&ust=1663286397950260&usg=AOvVaw2i1rbhrhuDim9CEIBBhpqb

Schaefer, S. E., Ching, C. C., Breen, H., & German, J. B. (2016). Wearing, thinking, and moving: testing the feasibility of fitness tracking with urban youth. *American Journal of Health Education*, *47*(1), 8-16.

Schmidt, P., Gordoni, G., Ajzen, I., Beuthner, C., Davidov, E., Silber, H., ... & Weiß, B. (2022). Twitter users' privacy behavior: A reasoned action approach. *Social Media+ Society*, *8*(3), https://doi.org/10.1177/20563051221126085

Schwarz, A. (2012). How publics use social media to respond to blame games in crisis communication: The Love Parade tragedy in Duisburg 2010. Public Relations Review, 38(3), 430-437.

Sebata, E., Mollah, M.R.A. (2022). Technology Application in Tourism Festivals in Asia: Theoretical Discussions. In: Hassan, A. (eds) Technology Application in Tourism Fairs, Festivals and Events in Asia. Springer, Singapore. https://doi.org/10.1007/978-981-16-8070-0_2

Seddighi, H., & Baharmand, H. (2020). Exploring the role of the sharing economy in disasters management. *Technology in Society*, *63*, 101363.

Seebock, J. J. (2018). *Responding to High-Rise Active Shooters*. Naval Postgraduate School Monterey United States.

Seeger, M. Sellnow, T. & Ulmer, (1998). Communication, organization, and crisis. *Annals of the International Communication Association*, *21*(1), 231-276

Sellnow, T., & Seeger, M. (2021). Theorizing Crisis Communication. 2nd Edition. Wiley Publishing.

Shields, R. (2003). The virtual. New York: Routledge

Shipman, A., & Majumdar, A. (2018). Fear in Humans: A Glimpse into the Crowd-Modeling Perspective. *Transportation Research Record*, *2672*(1), 183–197. https://doi.org/10.1177/0361198118787343

Short, J., Williams, E., & Christie, B. (1976). The social psychology of telecommunications.

Sime, J. D. (1983). Affiliative Behaviour During Escape to Building Exits. Journal of Environmental Psychology, 3, 21-41.

Simon, T., Goldberg, A., & Adini, B. (2015). Socializing in emergencies—A review of the use of social media in emergency situations. *International journal of information management*, *35*(5), 609-619.

Slabbert, Y., & Barker, R. (2011) An integrated crisis communication framework for strategic crisis communication with the media: A case study on a financial services provider, Communication, 37:3, 443-465, DOI: 10.1080/02500167.2011.609996

Smith, E. R. (1999). Affective and cognitive implications of a group becoming part of the self: New models of prejudice and of the self-concept. In D. Abrams & M. A. Hogg (Eds.), Social identity and social cognition (pp. 183–196). Oxford, England: Basil Blackwell.

Snyder, M. (1987). Public appearances, Private realities: The psychology of self-monitoring. WH Freeman/Times Books/Henry Holt & Co.

Socievole, A., Caputo, A., De Rango, F., & Fazio, P. (2019). Routing in Mobile Opportunistic Social Networks with Selfish Nodes. *Wireless Communications & Mobile Computing (Online), 2019*, 15. https://doi.org/10.1155/2019/6359806

Sohn, T., Li, K. A., Lee, G., Smith, I., Scott, J., & Griswold, W. G. (2005). Place-its: A study of location-based reminders on mobile phones. In *International Conference on Ubiquitous Computing* (pp. 232-250). Springer, Berlin, Heidelberg.

Solaris, J. (2018). Event-technology: 133 trends, ideas and tools that work (2019 edition). Retrieved from https://www.eventmanagerblog.com/event-technology

Solove, D. J. (2012). Introduction: Privacy self-management and the consent dilemma. *Harvard Law Review*, *126*, 1880–1903.

Spears, R. (2021). Social influence and group identity. Annual Review of Psychology, 72, 367–390. https://doi.org/10.1146/annurev-psych-070620-111818

Stadtfeld, C., Takács, K., & Vörös, A. (2020). The emergence and stability of groups in social networks. *Social Networks*, *60*, 129-145. https://doi.org/10.1016/j.socnet.2019.10.008

Stark, T. H., Flache, A., & Veenstra, R. (2013). Generalization of positive and negative attitudes toward individuals to outgroup attitudes. Personality and Social Psychology Bulletin, 39(5), 608-622.

Stopczynski, A., Larsen, J. E., Lehmann, S., Dynowski, L., & Fuentes, M. (2013, March). Participatory bluetooth sensing: A method for acquiring spatio-temporal data about participant mobility and interactions at large scale events. In *2013 IEEE International Conference on Pervasive Computing and Communications Workshops (PERCOM Workshops)* (pp. 242-247). IEEE.

Stott, C., & Drury, J. (2017). Contemporary understanding of riots: Classical crowd psychology, ideology and the social identity approach. Public Understanding of Science, 26(1), 2–14. https://doi.org/10.1177/0963662516639872

Suler, J. (2004). The online disinhibition effect. *Cyberpsychology & behavior*, *7*(3), 321-326. https://doi.org/10.1089/1094931041291295

Sullivan, G. M., & Feinn, R. (2012). Using Effect Size-or Why the P Value Is Not Enough. *Journal of graduate medical education*, *4*(3), 279-82.

Tajfel, H. (1978). The achievement of inter-group differentiation. In H. Tajfel (Ed.), Differentiation between social groups (pp. 77–100). London: Academic Press

Tajfel, H. (1981). Social stereotypes and social groups. In J. C. Turner & H. Giles (Eds.), *Intergroup behaviour* (pp. 144–167). Oxford: Blackwell.

Tajfel, H., & Turner, J. C. (1979). An integrative theory of inter-group conflict. In W. G. Austin & S. Worchel (Eds.), The social psychology of inter-group relations (pp. 33–47). Monterey, CA: Brooks/Cole.

Tajfel, H., & Turner, J. C. (1985). The social identity theory of intergroup behavior. In S. Worchel & W. G. Austin (Eds.), *Psychology of intergroup relations* (2nd ed.). Chicago, IL: Nelson-Hall.

Talantis, S., Ho Shin, Y., & Severt, K. (2020). Conference mobile application: Participant acceptance and the correlation with overall event satisfaction utilizing the technology acceptance model (TAM); https://doi.org/10.1080/15470148.2020.1719949

Tan, M. L., Prasanna, R., Stock, K., Hudson-Doyle, E., Leonard, G., & Johnston, D. (2017). Mobile applications in crisis informatics literature: A systematic review. *International journal of disaster risk reduction*, *24*, 297-311. https://doi.org/10.1016/j.ijdrr.2017.06.009

Tang, W. Y., & Fox, J. (2016). Men's harassment behavior in online video games: Personality traits and game factors. *Aggressive behavior*, *42*(6), 513-521. https://doi.org/10.1002/ab.21646

Taraszow, T., Aristodemou, E., Shitta, G., Laouris, Y., & Arsoy, A. (2010). Disclosure of personal and contact information by young people in social networking sites: An analysis using Facebook profiles as an example. International Journal of Media & Cultural Politics, 6(1), 81-101. https://doi:10.1386/macp.6.1.81/1

Templeton, A. (2021). Future research avenues to facilitate social connectedness and safe collective behavior at organized crowd events; https://doi.org/10.1177/1368430220983601

Templeton, A., Drury, J., & Philippides, A. (2015). From Mindless Masses to Small Groups: Conceptualizing Collective Behavior in Crowd Modeling. *Review of General Psychology*, *19*(3), 215–229. https://doi.org/10.1037/gpr0000032

Terry, G., Hayfield, N., Clarke, V., & Braun, V. (2017). Thematic analysis. *The Sage Handbook of Qualitative Research in Psychology*, 17-37. Sage.

Thomas, A. (2020). NO PLACE TO HIDE: Privacy Implications of Geolocation Tracking and Geofencing. *Scitech Lawyer*, *16*(2), 20-23.

Tierney, K. Lindell, M. & Perry, R. (2001). Facing the Unexpected. Disaster Preparedness and Response in the United States. Joseph Henry Press.

Trainor, J.E., Murray-Tuite, P., Edara, P., Fallah-Fini, S. (2013). Interdisciplinary Approach to Evacuation Modeling. https://doi.org/10.1061/(ASCE)NH.1527-6996.0000105

Tripathi, G., & Singh, D. (2016). Heterogeneous Crowd-Sourcing and Data Fusion Model For Disaster Management Services. *Journal of Theoretical & Applied Information Technology*, *83*(2).

Torres, E., Moreira, S., Costa Lopez, R., (2018). Understanding How and Why People Participate in Crowd Events. Vol. 57, Issue 2. https://doi.org/10.1177/053901841875771

Trotter, W. (1921). *Instincts of the Herd in Peace and War*. Fisher Unwin.

Turner, A., & Penn, A. (2002). Encoding natural movement as an agent-based system: an investigation into human pedestrian behaviour in the built environment. *Environment and planning B: Planning and Design*, *29*(4), 473-490.

Turner, J. C. (1987). The analysis of social influence. In Turner, J. C. , Hogg, M. A. , Oakes, P. J. , Reicher, S. D. , & Wetherell, M. S. () Rediscovering the social group: A self-categorization theory. Oxford, England: Basil Blackwell

Van Rythoven, E. (2017). *The Fragility of Fear: the Contentious Politics of Emotion and Security in Canada* (Doctoral dissertation, Carleton University).

Van Winkle, C. M., Woosnam, K. M., & Mohammed, A. M. (2013). Sense of community and festival attendance. *Event Management*, *17*(2), 155-163.

Van Winkle, C.M., & Bueddefeld, J. (2020). Information and communication technology in event management. *Handbook of e-Tourism*, 1-22.

Van Winkle, C. M., MacKay, K. J., & Halpenny, E. (2018). Information and communication technology and the festival experience. In *The Routledge handbook of festivals* (pp. 254-262). Routledge.

Venkatesh, V., Morris, M. G., Davis, G. B., & Davis, F. D. (2003). User acceptance of information technology: Toward a unified view. *MIS quarterly*, 425-478. https://doi.org/10.2307/30036540

Von Sivers, I., Templeton, A., Köster, G., Drury, J., & Philippides, A. (2014). Humans do not always act selfishly: Social identity and helping in emergency evacuation simulation. *Transportation Research Procedia*, *2*, 585-593.

Wakefield, J.R.H., Hopkins, N. (2017). Help that Helps: Exploring Strategic Motivations in Intergroup Helping Transactions. In: van Leeuwen, E., Zagefka, H. (eds) Intergroup Helping. Springer, Cham. https://doi.org/10.1007/978-3-319-53026-0_8

Wang, H. Y., Liao, C., & Yang, L. H. (2013). What affects mobile application use? The roles of consumption values. International Journal of Marketing Studies, 5(2), 11. http://dx.doi.org/10.5539/ijms.v5n2p11

Wang, Y., & Perez-Quinones, M. (2015). Beyond "Geofencing": Specifying Location in Location-Based Reminder Applications. CHI EA '15: Proceedings of the 33rd Annual ACM Conference Extended Abstracts on Human Factors in Computing Systems. Pages 1767–1772. https://doi.org/10.1145/2702613.2732780

Ward, S. B. (1924). The Crowd and the Herd. *Mind*, *33*(131), 275-288.

Weppner, J., & Lukowicz, P. (2013). Bluetooth based collaborative crowd density estimation with mobile phones. In *2013 IEEE international conference on pervasive computing and communications (PerCom)* (pp. 193-200). IEEE.

Weyrich, P.  Ruin, I., Terti, G., & Scolobig, A. (2021). Using serious games to evaluate the potential of social media information in early warning disaster management, International Journal of Disaster Risk Reduction, Vol. 56, https://doi.org/10.1016/j.ijdrr.2021.102053.

White, G. L., & Hewit, B. (2023). Lewin's Behavior Equation to Explain the Differences in Internet Security Incidents. In *Proceedings of the ISCAP Conference ISSN* (Vol. 2473, p. 4901).

Wood, E. H., & Masterman, G. (2008). Event marketing: Measuring an experience. In *7th International Marketing Trends Congress, Venice* (Vol. 35).

Wukich, C. (2015). Social media use in emergency management. Journal of Emergency Management, 13(4), 281-294. https://doi.org/10.5055/jem.2015.0242

Xiao, Y., Huang, Q., & Wu, K. (2015). Understanding social media data for disaster management. *Natural hazards*, *79*, 1663-1679.

Xu, J. (2020). Does the medium matter? A meta-analysis on using social media vs. traditional media in crisis communication. *Public relations review*, *46*(4), 101947. https://doi.org/10.1016/j.pubrev.2020.101947

Yee, N., & Bailenson, J. (2007). The Proteus effect: The effect of transformed self-representation on behavior. *Human communication research*, *33*(3), 271-290. https://doi.org/10.1111/j.1468-2958.2007.00299.x

Yogameena, B., & Nagananthini, C. (2017). Computer vision based crowd disaster avoidance system: A survey. International journal of disaster risk reduction, 22, 95-129. https://doi.org/10.1016/j.ijdrr.2017.02.021

Yoon, C., & Kim, S. (2007). Convenience and TAM in a ubiquitous computing environment: The case of wireless LAN. *Electronic Commerce Research and Applications*, *6*(1), 102–112. doi:10.1016/j.elerap.2006.06.009

Yoon, H., Kim, J., Tan, F., & Hsieh, R. (2008, March). On-demand video streaming in mobile opportunistic networks. In *2008 Sixth Annual IEEE International Conference on Pervasive Computing and Communications (PerCom)* (pp. 80-89). IEEE.

Yuan, F., & Puchalsky, C.M. (2015). Multimodal Evacuation Simulation and Scenario Analysis in Dense Urban Area: Philadelphia, Pennsylvania, Case Study. *Transportation Research Record*. 2532(1):91-98. doi:10.3141/2532-11

Zaki, J. (2020). Catastrophe compassion: Understanding and extending prosociality under crisis. *Trends in cognitive sciences*, *24*(8), 587-589. https://doi.org/10.1016/j.tics.2020.05.006

Zajonc, R. B., & Sales, S. M. (1966). Social facilitation of dominant and subordinate responses. *Journal of Experimental Social Psychology*, *2*(2), 160-168. https://doi.org/10.1016/0022-1031(66)90077-1

Zhu, Y., Xu, X., & Pan, B. (2023). A method for the dynamic collaboration of the public and experts in large-scale group emergency decision-making: Using social media data to evaluate the decision-making quality. Computers & Industrial Engineering, 176, https://doi.org/10.1016/j.cie.2022.108943

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