

Use of Emotional Response Modeling to Develop More Effective Risk Communication for Limited Literacy Adults: Evaluation of a “Dirty Bomb” Decision Aid

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Abstract

Behavioral, attitudinal, and emotional reactions to terrorism can be minimized by communication that promotes successful response through preparedness. However, a challenge to adequate preparedness is the substantial proportion of adults with “below basic” or “basic” literacy skills and how this affects development of health messages. This research explored whether a non-verbal emotional measurement and modeling technique (AdSAM®) can be used with a limited literacy population to support the development of message strategies for disaster situations such as a “dirty bomb” terror event. Adults with limited literacy were randomly assigned to review either a standard CDC decision aid written at a 9th grade level (n=22) or an adapted aid written at a 6th grade level (n=28). Using the AdSAM® emotional response instrument, participants answered questions regarding their feelings about a ‘dirty bomb’. The group shown the adaptive aid had more positive emotional responses, including less arousal and greater empowerment. The AdSAM® approach can provide researchers with insights into the design of tailored messages for a limited literacy population in high risk, high-emotion situations.

Key Words: Emotional Response Modeling, Radiation Terror Event (RTE), Limited-literacy, AdSAM

Introduction

Terror events have occurred in the US involving explosive devices—beginning in 1886 with a bomb tossed into a labor rally at Haymarket square in Chicago and most recently the bombing in Boston—creating a focus of concern around both domestic and foreign terrorism. Public response to terrorism can be affected by intense emotional reactions which are often the result of how information is conveyed, who conveys the information, and whether that information is developmentally and culturally relevant. The behavioral, attitudinal, and emotional reactions to terrorism can be minimized by influencing population response through a number of

factors, importantly, communication to ensure successful response through preparedness (National Research Council Staff, 2002).

However, one significant challenge to adequate preparedness is literacy. The *National Assessment of Adult Literacy* (NAAL) found that approximately 93 million adults have “below basic” or “basic” literacy skills (White, 2003), and an Educational Testing Service (ETS) report predicts that limited literacy will reach epidemic proportions by 2030 (Kirsch, Braun, Yamamoto, & Sum, 2007). This prevalence has significant implications for communicating threats around terror, especially those that may be difficult to conceptualize, such as an

explosion that includes radiation exposure. Effective preparedness communication is thus a critical issue and the focus of a growing body of research investigating innovative methods for creating materials easily accessible to those with limited literacy. Acknowledging the impact of emotion in preparedness communication, this study explores the use of a novel non-verbal emotional response methodology to evaluate communication targeted to an urban limited literacy population focused on one form of terror event -- a radiation terror event (RTE) or 'dirty bomb'.

Background

Limited literacy looms as a barrier to effective communication (Kirsch et al, 2007; Parker, Wolf, & Kirsch, 2008). This has grave implications for risk communication, which has become an increasingly important in recent years. Risk communication must provide the public with the information and skills required to ameliorate, diminish, or appropriately react to effects of hazardous situations which may result from natural disaster, technological catastrophes, or terrorism (Childress, 2003; Covello & Allen, 1994). One potential terror threat is a radiological event such as the explosion of a "dirty bomb", an explosive bomb that can spread low-grade radioactive material over a large geographic area.

Government entities such as the Centers for Disease Control and Prevention (CDC) acknowledge the potential threat of a radiological terror event (RTE) (CDC, 2005). These agencies have developed emergency preparedness guidelines and materials required to manage the event and ensure population safety. Many of these materials, however, are written at a 9th grade reading level or higher, making them inaccessible to a substantial number of people with low literacy.

Risk Communication and Emotion

Responses to threats are often related to the concept of risk and whether an individual perceives that risk to be serious. Risk is a subjective concept, one that Slovic and Weber (2002) noted we have invented to help us understand and cope with the dangers and uncertainties of life. This subjectivity makes effective risk communication an especially daunting task. Risk communication must contextualize, for heterogeneous groups in the population, perceived versus actual (probability based) risks and benefits, as well as the uncertainties and ambiguities that accompany a crisis. A heightened sense of emotion often accompanies the crisis, affecting how individuals make sense of the situation and how they decide on a course of action. While this risk perception can be skewed in any

population, it may be especially skewed in a group with low literacy who may have a harder time cognitively assessing risks and benefits. In order for health and risk communication efforts to be successful, it is important to match messages to the literacy skills of the intended audience to ensure comprehension and the ability to adequately judge risks and benefits. As such, providing information about an RTE and "dirty bomb" is further complicated by the fact that even with the proliferation of material focused on this topic, the public at large does not have a good understanding of the recommended action to take in the event of a RTE (Ahearne, 2010). Specifically, there has been little emphasis placed on assessing how those with limited literacy comprehend and respond to RTE materials – responses that will have a direct effect on the health and safety of this vulnerable population.

In addition, for more than thirty years researchers have acknowledged the significance of emotions in risk perceptions. Fischhoff characterized risk as involving two factors - unknown (uncertainty) and dread, with dread being the prominent emotion experienced when addressing risk (Fischhoff, Slovic, Lichtenstein, Read, & Combs, 1978). Emotion as a key component of risk appraisal has also been addressed in a number of other theories and models (Slovic, Finucane, Peters, & MacGregor, 2002; Loewenstein, Weber, Hsee, & Welch, 2001; Mellers, 2000). More recently, Xie and colleagues maintained that understanding the role of emotions in risky or emergency situations is critical to creating effective risk communication (Xie, Wang, Zhang, Li, & Yu, 2011). They found that emotions mediated the relationship between the mode of presentation/type of hazard and the outcomes of risk perception and subsequent action. How this effect may differ among those with varying literacy levels, however, has not been investigated.

Two primary theoretical frameworks underlie the study of emotion – discrete or dimensional emotion theory (Mehrabian & Russell, 1974; Osgood, Suci, & Tannenbaum, 1957).

Discrete emotion theory holds that all emotion stems from a set of innate and universal emotions that include constructs such as fear, anger, disgust, sadness and happiness.

Dimensional emotion theory posits that emotional states are organized in terms of a limited number of underlying dimensions. The two dimensions almost universally considered fundamental are valence (positive versus negative) and arousal (high versus low), and these dimensions translate to pleasure-displeasure and activation-deactivation (Mehrabian & Russell, 1974). A third dimension, which is not consistently included, has

been defined as dominance, potency, or tension (Scherer, 2005).

The dimensional perspective of emotion is widely supported in the literature. A review by Mauss and Robinson (2009) states that the ability of the dimensional perspective to capture specific emotional states results in a more parsimonious, and therefore favored perspective. These authors point to the fact that when evaluating autonomic nervous system (ANS) activity it has been difficult to prove the existence of discrete emotions, while the dimensional framework does provide explanatory value.

The goal of this research is to explore an approach to evaluating emotional responses to risk communications among individuals with limited literacy that could provide valuable input into communication design, and to determine whether the evaluation of emotional response can provide insight into how best to design risk communication materials for limited literacy populations. This approach applies an emotional response modeling tool based on the three dimensional framework of emotion and used in a number of different disciplines outside of public health or health communication. Although various researchers have pointed to heightened emotions during an emergency event and have discussed how to attend to these emotions in risk communications (Turner, 2007; Keller, Siegrist, & Gutscher, 2006; Meijnders, Midden, & Wilke, 2001), no research has focused on using emotion to assess the efficacy of risk communication materials. This study thus fills a gap in the literature about how emotional response can be integrated into health communication evaluation techniques and its utility in low literacy populations.

Methods

Study Protocol

The pilot study presented here is a randomized control trial testing the efficacy of a decision aid designed for a low literacy population. It is the fourth phase of a multi-stage protocol.

In Phase I, focus groups with limited literacy individuals (N=30 with $\leq 6^{\text{th}}$ grade reading level) were conducted in order to inform the design of a survey instrument to assess perceptions of a "dirty bomb" terrorist event. The survey instrument was developed in Phase II and administered to 100 individuals with limited-literacy. In Phase III, based on the Phase II survey results, an adapted risk communication decision aid was designed about "dirty bomb" RTEs, targeted to limited-literacy individuals. The decision aid was then pre-tested among 10 individuals with limited literacy and

adjustments were made to the decision aid based on the feedback.

Participants in this Phase IV pilot were recruited both in-person and by telephone. In-person recruitment was conducted in North Philadelphia neighborhoods at churches, a community center, and a youth health program. In addition, flyers posted in North Philadelphia locations including area hospitals, churches, community centers, wellness centers, and state aid offices were used to generate interest and solicit calls from area residents, who were then screened by telephone to participate.

Study Participants

Criteria for inclusion included being aged 18 or over and the ability to understand and sign the consent to participate in English. Individuals screened in-person were administered the eight-item standardized *Rapid Estimate of Adult Literacy in Medicine-Revised* (REALM-R) and a score of five or below was required for participation in the study (Davis, Long, & Jackson, 1993). The eight-item REALM-R takes less than two minutes to administer and score. Participants are asked to pronounce 11 words, the first three of which are not scored. If the patient is unable to pronounce six or more of the remaining eight words, the patient is classified as being at risk of low literacy. Validation studies show that patients who score at or below 6 on the REALM-R are unable to read at a sixth-grade level (Bass, Wilson, & Griffith, 2003).

Individuals screened by telephone were asked to respond to two questions (Chew, et al., 2008):

How often do you have someone help you read health-related materials?

How confident are you filling out forms by yourself?

Responses were scored on a 5-point Likert scale and individuals were eligible to participate if they answered either 'sometimes', 'often' or 'always' on the first question or 'somewhat', 'a little' or 'not at all' on the second question. These questions have been highly correlated with other literacy measures, including the REALM-R, and have been used for over-the-phone literacy screening (Chew, et al., 2008).

In addition, because the Philadelphia population is primarily Black or White (Hispanic or Non-Hispanic) with less than 5% of all residents in other racial groups, members of other racial/ethnic groups were not actively recruited. Participants were provided with an incentive (\$20 gift card to a local store plus travel tokens) to take part in the study. All materials and procedures were approved by the University Institutional Review Board.

Study Procedures

Testing was conducted in-person at a University academic location. Eligible participants were scheduled to come to a designated location at the University where research assistants, trained on all study protocol, reviewed the study objectives and procedures with participants, then reviewed the consent form and asked them to sign the document. Prior to testing, subjects responded to demographic questions, as well as the baseline emotion questions described below.

The intervention decision aid (described in Phase III above) was designed specifically for individuals with limited literacy. It was written at an elementary grade reading level, included pictures to inform the text, and used short sentences and bullet points to assist with ease of reading. To ensure continuity, the “Frequently Asked Question” format was also used in the intervention decision aid. The control and intervention messages were presented on a computer monitor for each participant to review. At the conclusion of the review, participants completed a questionnaire. Although the questionnaire was designed for a limited literacy participant, each question was also read aloud by the research assistant. The full study took approximately 45 minutes to administer.

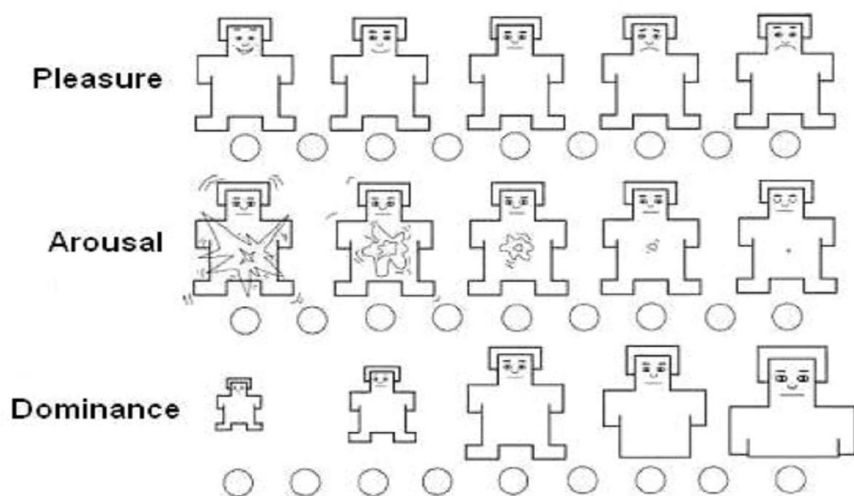
The survey questions comprised five categories: a Decisional Conflict Scale and an Intent to Take Action Scale (O’Connor, 1995), an adapted material acceptability scale (Graham & O’Connor, 1995),

a perceptual mapping instrument, and the AdSAM® emotional response instrument (Morris, 1995). The discussion below focuses on the responses to AdSAM®.

About AdSAM®

The three dimensional theory of emotion described above was operationalized by Lang (1980) through a picture-oriented instrument called the Self-Assessment Manikin (SAM) (See figure 1). The SAM methodology has been used to measure emotional responses in a broad range of categories and across numerous disciplines including music (Vuoskoski & Eerola, 2011), color (Suk & Irtel, 2010), human-computer interaction (Peter & Herbon, 2006), website evaluation (Dormann, 2001), store layout (Petermans, Van Cleempoel, & Nuyts, 2009), shopping experience (Machleit & Eroglu, 2000), and customer service environments (Lin & Liang, 2011). SAM has been commercialized and validated as AdSAM® (Morris, 1995) gaining wide acceptance for use in emotion measurement. Although the SAM methodology has successfully been used to determine the subjective experience of emotion in a broad range of categories and across numerous disciplines, it has never been applied to evaluate emotional response to health or risk communication. The current study explores the value of the approach in this setting using AdSAM®. Further information regarding AdSAM®, how it has been validated and used can be seen at www.adSAM.com.

Figure1 Application of AdSAM® in the Current Study



Morris, J. D. (1995). Observations: SAM: The self-assessment manikin. An efficient cross-cultural measurement of emotional response. *Journal of Advertising Research*, 35(6), 63-68.

Note: Row one represents pleasure, row two represents arousal and row three represents dominance

The Self-Assessment Manikin visually assesses each Pleasure, Arousal, and Dominance dimension using graphic characters arrayed along a continuous nine-point scale. The first row of figures is the *pleasure scale*, which ranges from a smiling, happy face to a frowning, unhappy face. The second row is the *arousal scale*, which ranges from extremely calm with eyes closed to extremely excited with eyes open and elevated eyebrows. The third row, the *dominance scale*, represents changes in control with a large figure indicating maximum control to a tiny figure that indicates not being in control. To use AdSAM®, participants were provided with a simple verbal description of each scale and asked to quickly choose the manikin (SAM) in each row that best identifies how they feel (Morris, Woo, & Cho, 2003).

Six questions were administered using the AdSAM® scales. The AdSAM® instructions and questions were read to the participants who noted their responses on a pre-prepared form showing the SAM manikins. Prior to viewing the decision aid the participants answered three questions:

- *How do you typically feel on a Monday morning?* (A control question which helps to orient the participant to the scales and serves as a baseline score)
- *How do you feel about the possibility of a “dirty bomb”?*
- *How do you feel about your ability to protect yourself and your family in the event of a “dirty bomb”?*

Three questions were asked following review of the decision aid:

- *How did the Decision Aid make you feel?*
- *How do you feel about your ability to follow the instructions as described?*
- *How do you feel about your ability to protect yourself and your family in the event of a “dirty bomb”?*

These questions were included to assess the effectiveness of the CDC Frequently Asked Questions (control) decision aid compared to the intervention decision aid for providing information about a “dirty bomb” and how to respond if one occurs. Specifically, we wanted to determine whether the emotional responses of the intervention group reflect a greater understanding of the messages compared to the control group among this limited literacy population.

The three dimensions of each AdSAM® question were translated into a PAD score and these mean PAD scores were used to create dimension maps

(See figures 2 and 3). According to AdSAM® protocol, Pleasure is referred to as Appeal, Arousal as Engagement, and Dominance as Empowerment. The mean Pleasure and Arousal scores for the control and intervention groups are depicted by the positioning of dots on the dimension maps (blue for control, green for intervention), and Dominance is depicted by the size of the dot (Morris, 1995). Shifts in emotional response are observed by movement of the dots and size of the dots on the maps.

In the AdSAM® model, 153 emotion-denoting adjectives have unchanging positions based on prior factor analyses of the emotions. These factor analytic studies established the positioning of the emotions relative to each other and resulted in the Pleasure, Arousal and Dominance labels for the dimensions. Thus, the positioning of the emotions relative to each other in the figures remains the same while the positioning of the participant groups changes.

The 1-9 scale used to code the AdSAM® responses created means for each of the dimensions. Independent sample t-tests were conducted using SPSS version 20 to compare the control and intervention groups on the Pleasure, Arousal and Dominance (PAD) dimensions of all AdSAM® questions. Paired t-tests were used to assess within group changes to the same AdSAM® questions asked both before and after viewing the decision aids.

Results

Sample Characteristics

Of the total participants (N=50), 85.7% self-identified as African American, 6.1% as White, and the remaining as a combination of Asian, Native American, and Mixed race. Most participants considered themselves to be Non-Hispanic (93.6%) and their mean age was 44 years (range of 23-67). Gender distribution was fairly equal, with 51% men and 49% women.

Literacy Level

Although screened for low-literacy, almost 64% of the participants reported having graduated from high school or higher, or receiving their GED. Of those 26 participants screened for literacy using the REALM-R, two thirds (65%) were unable to pronounce more than 2 out of 8 scored words, indicating very low literacy (mean=2.04). Of those participants screened for literacy by telephone, over 80% indicated they were somewhat or not at all confident filling out forms (84%); over 90% (94.7%) sometimes or often needed help with instructions.

AdSAM® Results – Pre-exposure to Decision Aid

AdSAM® results for the questions asked prior to viewing the decision aid are shown in Figure 2. For the first question regarding how participants typically feel on a Monday morning, the map indicates that participants in both the control and intervention groups typically feel positive and calm on Monday mornings (See figure 2(a)). The second question, asking participants how they feel about the possibility of a “dirty bomb”, demonstrates a marked shift in both groups compared to the first question. A highly negative

emotional response to the possibility of a RTE is evident, along with a moderate level of arousal. The size of the dot indicates that participants feel a low level of control. The semantic space, containing adjectives such as suspicious, disbelieving, and troubled, is consistent with expected reactions to this topic (See figure 2(b)).

The third question, which asks about the participants’ ability to protect themselves or their family in the event of a “dirty bomb”, shows mean pleasure and arousal scores in the center of the dimension map, along with a fairly low level of control (See figure 2(c)).

Figure 2 Questions asked prior to viewing the decision aids

Figure 2(a) How do you typically feel on a Monday morning?

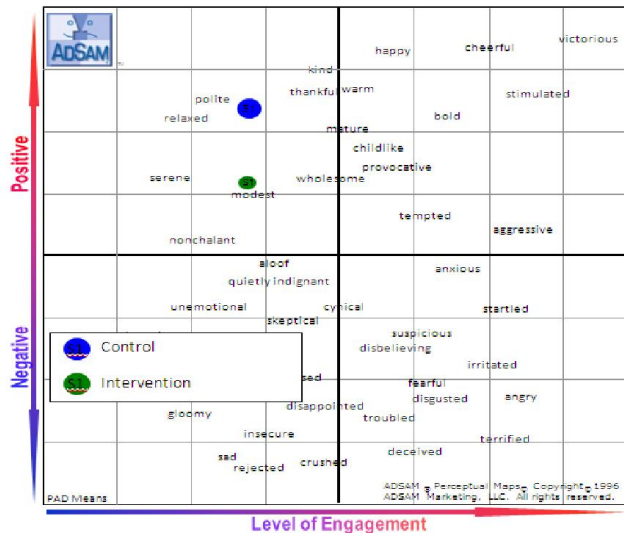


Figure 2(b) How do you feel about the possibility of a “dirty bomb”?

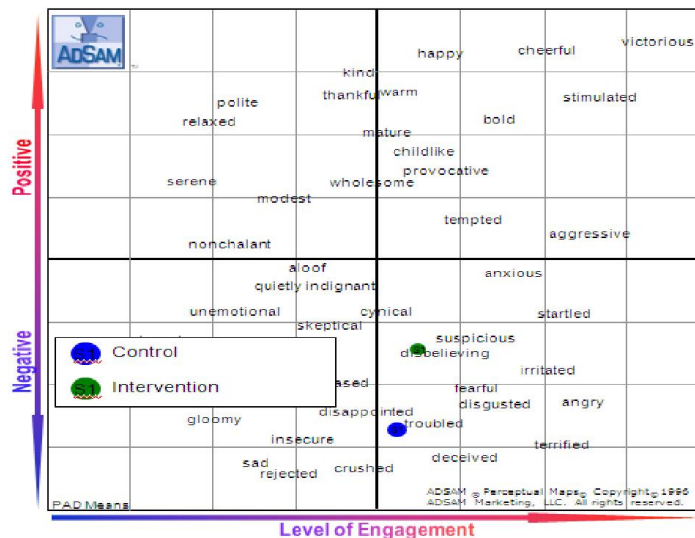
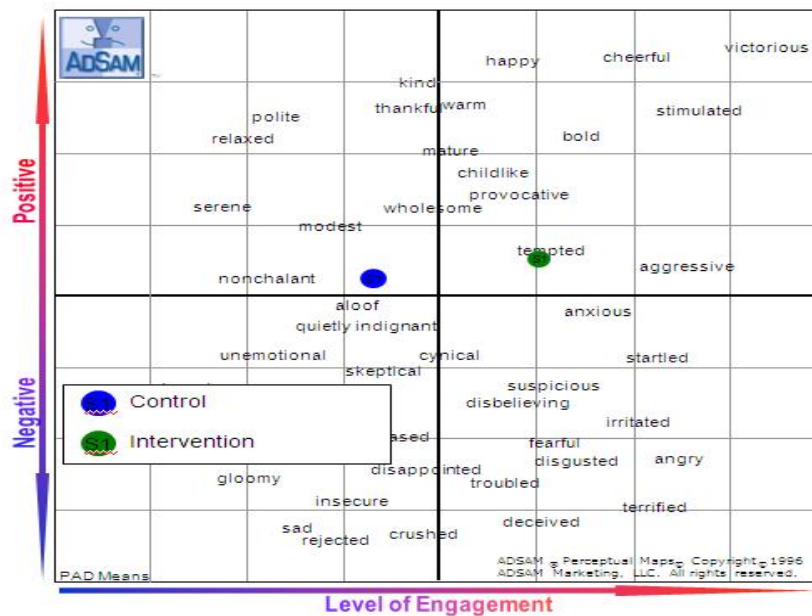


Figure 2(c) How do you feel about your ability to protect yourself and your family in the event of a 'dirty bomb'?



The next three AdSAM questions were asked subsequent to the participants' exposure to either the CDC-created or the adapted decision aids (See figure 3). When asked how the decision aid made them feel, participants in both groups showed they were in a more positive emotional space, had a moderate level of arousal, and both demonstrated a higher level of control. Regardless of which set of messages they reviewed, the availability of information appeared to be beneficial for the participants. No clear distinctions between the control and intervention groups are evident (See figure 3(a)).

Differences, however, are seen between the control and intervention groups when asked how they feel about the ability to follow instructions. Both groups demonstrate an emotional response that is positive and both groups show greater control than they did in response to previous questions. However, the intervention group is more positive, calmer (less aroused), more comfortable, and more in control (See figure 3(b)). Finally, following exposure to the decision aids, participants were again asked how they feel about their ability to protect themselves and their family in the event of a "dirty bomb". The group that viewed the

intervention decision aid demonstrates an emotional response that is more positive and more in control; the group that viewed the CDC decision aid appears to be more aroused. The AdSAM® scores on this question before and after exposure to the decision aids display a shift for both groups to a more positive space after information was provided (See figure 3(c)).

Statistical Testing

Independent samples t-tests were used to compare the control and intervention groups on the Pleasure, Arousal, and Dominance dimensions for each of the AdSAM® questions (Table 1). The post-exposure scores demonstrate a significant difference between the control and intervention groups on how the participants feel about their ability to follow the instructions described on both the Pleasure ($t= 2.36, p=.023$) and Arousal ($t=-2.47, p=.017$) dimensions (See table 1(a)). However, the other two post-exposure questions, how did the decision aid make you feel and how do you feel about your ability to protect yourself and your family, show no significant difference between the control and intervention groups.

Table 1(a) Comparison of control and intervention groups on pleasure, arousal, and dominance dimensions for post-exposure questions

Question	Segment	N	P	A	D
How did the Decision Aid make you feel?	Control	20	7.60	4.95	7.75
	Intervention	27	6.63	4.40	7.81
How do you feel about your ability to follow the instructions as described?	Control	20	7.45	6.00	8.25
	Intervention	27	8.56_i	3.44_i	8.15
How do you feel about your ability to protect yourself and your family in the event of a RE?	Control	20	7.25	6.40	6.75
	Intervention	27	8.41	5.22	7.22

_i = Intervention group significantly different from Control group

Table 1(b) Comparison of control and intervention groups on pleasure, arousal, and dominance dimensions pre- and post-exposure

Question	Segment	N	P	A	D
Pre-exposure: How do you feel about your ability to protect yourself and your family in the event of a RE?	Control	21	5.24	4.33	6.19
	Intervention	27	5.52	6.04	5.52
Post-exposure: How do you feel about your ability to protect yourself and your family in the event of a RE?	Control	20	7.25_a	6.40_a	6.75
	Intervention	27	8.41_a	5.22	7.22_a

_a = Post-exposure responses significantly different from pre-exposure responses

Paired samples t-tests were used to assess whether the participants felt better able to protect themselves and their family after exposure to the messages than prior to the exposure (See table 1(b)). Both the control and intervention groups demonstrate significantly higher scores on the Pleasure dimension

following exposure to the messages (*Intervention: t=4.46, p<.001; Control: t=-2.49, p=.022*).

The control group demonstrates a higher level of Arousal (*t=-2.80, p=.011*) post-exposure. While the intervention group has significantly higher Dominance scores from baseline to post (*t=-2.54, p=.017*), this same effect was not evident in the control group.

Figure 3 Questions asked after viewing the decision aids

Figure 3(a) How did the decision aid make you feel?

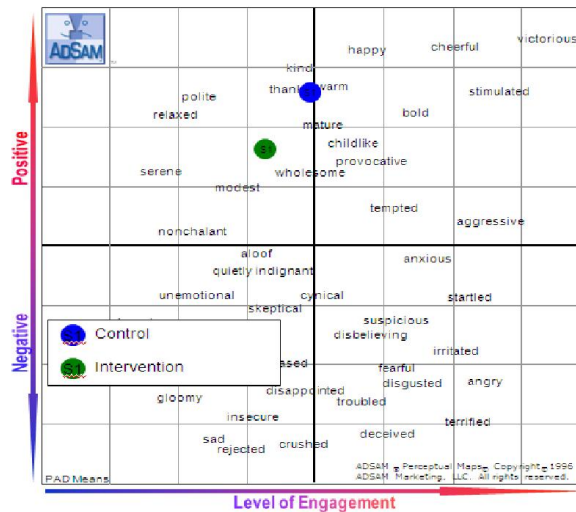


Figure 3(b) How do you feel about your ability to follow instructions as described?

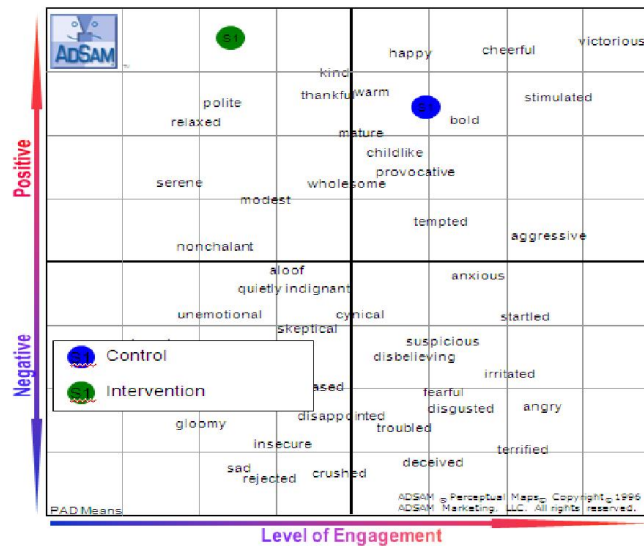
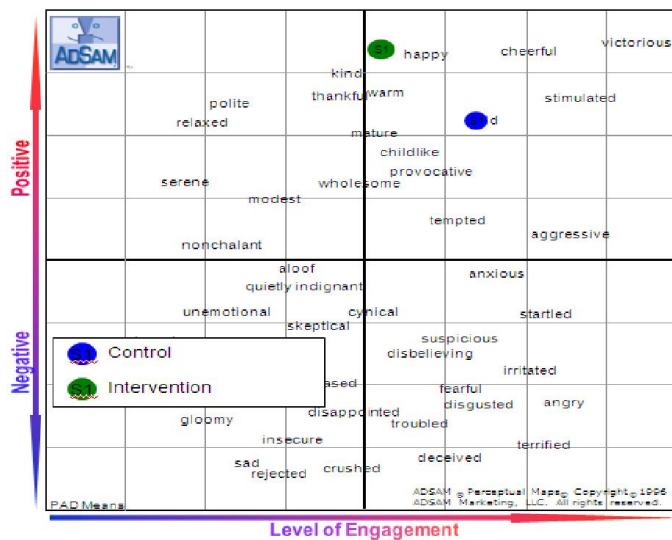


Figure 3(c) How do you feel about your ability to protect yourself and your family in the event of a “dirty bomb”?



Discussion

Within the context of a “dirty bomb”, this study explores whether the evaluation of emotional response, using the AdSAM® emotional response measurement tool, can provide insight into how best to design health-related risk communication materials for limited literacy populations. If the topic and/or the decision aids did not elicit an emotional response, we would not expect to see discrimination in the AdSAM® measures between groups prior to and following exposure to the decision aids. However, movement of the AdSAM® PAD scores

from the baseline to the more specific “dirty bomb” questions for the control and intervention groups indicates that the AdSAM® measures do reflect variations in emotional response among this population. This movement indicates not only that lower literacy populations can be effectively measured using emotional response measures but that the measures can show specific and meaningful differences between groups. These differences can provide researchers with important insights into the effects of specific messages on emotional responses, especially in high risk, high

emotion situations such as a “dirty bomb” scenario. It also indicates that the method can be used in low literacy populations and provide valid results that can be used to evaluate the potential effect of risk communication materials.

Focusing on the questions asked prior to viewing the decision aid, the AdSAM® measures provide information about the participants’ emotional responses to this category of threat. The negative pleasure and the moderately high level of arousal associated with participants’ reactions to the possibility of a “dirty bomb” are not unexpected, and are associated with feeling troubled and concerned. The threat itself carries harmful connotations, which is reflected in the pleasure-displeasure dimension. However, we speculate that the moderately high level of arousal is consistent with a topic the participants may not have previously considered and is not perceived as an imminent threat. Similar pre-test ratings were seen when asked about the ability to protect themselves and their family. The emotional response, which shows moderate levels of pleasure and arousal along with low control, may reflect the lack of information participants have about a “dirty bomb”. They feel generally positive about their abilities to provide protection but because of their uncertainty about what a “dirty bomb” is, tend to be more aroused and anxious.

Following exposure to the decision aid, both groups demonstrate an overall move to a more positive space on all of the dimension maps. However, differences are evident between the control and intervention groups. Participants in the intervention group are more positive, calmer (less aroused) and are more in control regarding their ability to follow instructions, possibly resulting from a better understanding of the information presented by the adapted, low-literacy decision aid. In terms of participants’ ability to protect themselves and their family, the group that viewed the intervention decision aid demonstrates an emotional response that is more positive and more in control; the group that viewed the CDC decision aid shows greater arousal. This arousal might indicate difficulty in comprehending the information presented and therefore signal some confusion about the appropriate action to take in the event of a radiation emergency. It may also indicate uneasiness with the information and testing process, having been provided material that they were not able to adequately read. This general stress may reflect the emotional effect that inappropriate, high literacy materials may have on populations with limited literacy.

We evaluated the between-group PAD scores to understand if the intervention group demonstrated a greater emotional shift than the control group. We expected higher pleasure and control scores on our

behavior intention outcome measure of participants’ ability to protect themselves and their family in the event of a radiation emergency. This did not occur, and we speculate that the brief exposure to this RTE information was not sufficient to create a sense of confidence around the expected behavior. Also, the intention to stay home and “shelter in place”, which was a key message of the materials, may need more repetition to be effective. In the event of a “dirty bomb”, many have the first inclination to “get out of town”. When posed with the question of whether they would leave or stay, despite being told why they should stay, the instinct to get family members and leave is strong. However, we do see a significant difference between the groups on the measure that focuses on the participants’ reported ability to follow instructions. The higher Pleasure score and lower Arousal score demonstrated by the intervention group compared to the CDC control group suggests a better understanding of the information presented by the intervention decision aid. This may be a precursor to a later behavioral response if messages are repeated over time and are literacy appropriate.

Evaluating the pre- and post-PAD scores on the participants’ ability to protect themselves and their family, the significantly higher level of Arousal post-exposure demonstrated by the control group may indicate that the information was not sufficiently understood to provide the participants with confidence that they can address an RTE. The significantly higher Dominance scores from baseline to post-exposure showed by the intervention group lead us to believe that this approach was more successful in promoting an increased sense of control – an important finding. If literacy appropriate messages can provide people with a greater sense of control in high stress situations, other preparedness or risk messages can be crafted to ensure proper response in the event of an emergency. This has wide communication implications in that having a sense of control is a key component of emergency risk communication and is related directly to compliance with recommendations (Covello & Sandman, 2001).

Finally, there is discussion in the literature about the contribution of Dominance as a third dimension when evaluating emotion, however it is often dropped due to insufficient effect. We argue that the Dominance dimension is important in the context of risk communication and can provide a powerful explanation for the effects of messages in emergency situations. Dominance may not be as important in everyday decision-making, such as product purchasing, but it is likely to be more influential in the area of risk communication, where dominance or control can be a powerful emotional determinant. This may be especially true in the context of a crisis or emergency such as a

“dirty bomb” explosion. The more a message can enhance feelings of control in an individual, the more he/she will be able to accept and execute appropriate actions.

Limitations

This study used a convenience sample of 50 limited-literacy, primarily African American men and women living in North Philadelphia. As such, our results cannot be generalized beyond this study population. In addition, interviewing was conducted at a University and it is possible that this study setting, and by extension, the research assistants who worked with the participants, could have been intimidating. This may have affected the way people responded to the materials or caused people to feel they needed to respond in a certain manner. However, because participants were randomized to treatment groups, the differences we saw in emotional response provide evidence that there was a true difference and not an artificial response to study setting or materials.

Conclusions

This study provides an exploratory understanding of whether an assessment of emotional response can support the design of targeted, literacy

appropriate decision aids. The utility of the AdSAM® emotional response measurement tool to nonverbally capture and graphically display how limited-literacy individuals respond to risk communication messages is also evaluated. Although this technique has been used successfully in a variety of academic and commercial settings, using it to assess risk communication materials in this limited literacy, at-risk population is a novel application of the method. That this measure is non-verbal and requires a quick visceral response rather than comprehension of an array of specific questions, makes this tool especially appropriate for populations with linguistic or literacy challenges. In addition, it is unobtrusive, easy to administer, and inexpensive to use and analyze, adding to its value as a stand-alone tool or adjunct to other measures.

We feel these preliminary results warrant additional research into the use of emotional response and how this tool can be used to optimize message strategies targeting limited literacy individuals. This approach appears to have particular strength for identifying and thus enhancing feelings of control and empowerment. If shown to be valid and reliable, it could have wide application when developing and testing future preparedness messages for populations with limited literacy.

Disclosure

The authors have no conflicts of interest, financial or otherwise, to declare for this article.

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