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A New Flashbulb Memory Model Applied to the Marmara Earthquake

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SUMMARY

This study was based on the recollections of people who experienced the Marmara earthquake and those who had no direct experience with it but only heard it on the news. Four models of flashbulb memory (the photographic model, the comprehensive model, the emotional-integrative model and the importance-driven emotional reactions model) were compared in the study. Findings indicated that the importance-driven emotional reactions model provided a better fit to the data than the others for victim and comparison groups. In order to verify the accuracy and consistency of flashbulb memories, a small sub-sample of participants from both groups was tested twice after the first anniversary of the quake. The results indicated that the Marmara earthquake was accurately recalled and flashbulb memories about the event are consistent after a delay of one year. Copyright © 2003 John Wiley & Sons, Ltd.

Flashbulb memory, which was first coined by Brown and Kulik (1977), has been used for unexpected, traumatic, vivid and important personal or national events. In many cases, such emotionally shocking events may be well preserved in people's memories for years. According to Brown and Kulik, these vivid recollections remain unchanged in the memory over time. Recently, contradictory findings have been obtained from studies of flashbulb memory. While some research has found people reporting remarkably accurate and stable memories as stated by Brown and Kulik (e.g. Conway *et al.*, 1994; Neisser *et al.*, 1996; Pillemer, 1984), others have found flashbulb recollections as inaccurate as other kinds of memories (e.g. Neisser, 1982; McCloskey *et al.*, 1988). In recent years, flashbulb memory studies have focused on assassinations or assassination attempts (see Christianson, 1989; Pillemer, 1984; Winogrod and Killinger, 1983) and disasters (see Bohannon, 1988; Wright, 1993; Christianson and Engelberg, 1999). The target events in flashbulb memory studies have almost always been negative events (except for a few studies: e.g. Tekcan, 2001 compared a negative and a positive event).

In one study Wright *et al.* (1998), investigated people's flashbulb memories for the resignation of Margaret Thatcher and the Hillsborough football tragedy. They found that the flashbulb memories of the subjects differed depending on their social class, age and gender. In this study, males reported having clearer flashbulb memories, compared with females, of the Hillsborough disaster even though they felt it was less important and less

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emotional for them. Results also showed that the Hillsborough disaster was rated as more emotional and important than Thatcher's resignation even though it was not recalled as vividly as the latter. In another study, Christianson and Engelberg (1999) investigated flashbulb memories of the Estonia ferry disaster on the Baltic Sea. The emotional reactions of the subjects were measured shortly after the event and a year later. Results showed that personal circumstances when hearing the news of the Estonia ferry disaster were well retained, although far from perfect. Neisser and Harsch (1992) examined participants' memories of the Challenger Space Shuttle explosion and found that although participants were highly confident about their memories for this event, just three years after the event their memories were not very accurate.

Shum (1998) pointed out that a more reasonable experiment would elicit individuals' own flashbulb memories, rather then viewing them in terms of public occurrences. The findings mentioned here raise the question of whether these public events are the main types of events about which people have flashbulb memories. Although it is expected that flashbulb information is not as rapidly diminished as normal information, the results of some investigations showed that flashbulb information decreases in time. According to Brown and Kulik (1977), the special flashbulb mechanisms may operate only in situations involving a strong emotional reaction.

Rubin and Kozin (1984) have demonstrated flashbulb memories formed by personally important life-events rather than national events. They asked undergraduate students to describe their three clearest flashbulb memories and to rate the national importance, personal importance, level of surprise, consequentiality, vividness, and emotionality associated with each event on a 7-point Likert type scale. Most of the events reported by the students were the ones that they had experienced directly (e.g. car accident, sexual encounters). The resulting 174 memories were almost all rated to be high in personal importance, but low in national importance. Students had difficulty recalling national events such as assassinations. Like Pillemer (1984), Rubin and Kozin found no effect of consequentiality or number of rehearsals. Unlike Pillemer's findings there was no major effect of emotions. In fact, they found that the flashbulb memories of the subjects were mostly affected by personal importance and vividness. Furthermore, many previous studies had suggested that importance, emotional reaction, and number of rehearsals played a key role in the maintenance of vivid memories (e.g. Bohannon, 1988; Bohannon and Symons, 1992; Conway *et al.*, 1994; Finkenauer *et al.*, 1998; Wright *et al.*, 1998; Wright and Nunn, 2000).

One of the most interesting recent flashbulb memory studies was reported by Neisser *et al.* (1996) and based on subjects who had direct experience with the 1989 California earthquake. Three groups of subjects were compared. The first group was from Berkeley, which had experienced a moderate earthquake, the second group was from the University of California in Santa Cruz, which had experienced much more severe conditions. For the informants in the Atlanta group, the earthquake was just something that happened thousands of miles away. Results showed that informants from Berkeley and Santa Cruz, who had experienced the quake, remembered much more than the Atlanta group. In addition, the California groups remembered their direct experience of the quake better than they remembered learning about the event. The most important finding of this study was that personal involvement in the event led to greatly improved recall. Moreover, this study revealed that individuals who had directly experienced the California earthquake in 1989 recalled their experiences accurately and confidently after a delay of a year and half.

FLASHBULB MEMORY MODELS

Several different models have been suggested to explain flashbulb memory. Brown and Kulik (1977), for example, who conducted the first formal study of flashbulb memory, proposed the photographic model of flashbulb memory formation. The authors chose 10 major events (mostly assassinations) to test this model. Individuals were asked whether they could recall the circumstances in which they first heard about the events which had taken place 10 to 30 years before. Conway *et al.* (1994) proposed another model to account for the formation of flashbulb memories. In this model, called a comprehensive model by Finkenauer *et al.* (1998), flashbulb memories are formed by three encoding factors (prior knowledge, importance and effect) and one post-encoding (rehearsal-elaboration) factor. They conducted a large test–retest study to examine the subjects' flashbulb memories concerning the resignation of the British Prime Minister Margaret Thatcher. In the study, subjects from different nations (UK, non-UK) completed a flashbulb memory questionnaire within 14 days of Margaret Thatcher's resignation. A sub-sample of these subjects was tested a second time approximately 11 months later. Finkenauer *et al.* (1998) have formulated another flashbulb memory model (an emotional-integrative model of flashbulb memory) on the basis of Belgian citizens' recollections about King Baudouin's death. They investigated subjects' recollections about the context in which they first heard about the event from news reports.

Summarized similarities and differences between the three models of flashbulb memory are shown in Figure 1. All three models agree that flashbulb memories are influenced by the same three variables: surprise, importance or consequentiality, and emotional state or affective reaction. Also, each model provides evidence for the crucial role of the unexpected situations (novelty and surprise) for the formation of flashbulb memories.

FLASHBULB MEMORIES FOR THE MARMARA EARTHQUAKE

The flashbulb memory studies present various problems. First, in the studies of flashbulb memory, the sample consisted of subjects who had heard about the event in the news rather than those who had experienced the event directly—except Neisser *et al.*'s (1996) study. The resulting problem is that one cannot determine whether the subjects are observing flashbulb or normal memory processes if, as a consequence of the shocking event, people do not experience emotional or affective states, or if there is no personal involvement in the event. According to Wright and Gaskell (1995), the sampling problem is critical in all naturalistic cognition and flashbulb memory studies. An event might be of flashbulb calibre for a small well-defined sub-set of the population, but be insignificant to most people. Second, many studies employed only small groups of subjects. According to Conway *et al.* (1994), the use of small sample sizes may be problematic, because it becomes very difficult to use multivariate analyses, which are essential if latent constructs such as flashbulb memories, effect, consequentiality/importance, rehearsal, and the relations between such constructs are to be assessed.

The aim of the present study is to test the various models of flashbulb memory by sampling large groups of subjects who experienced the Marmara earthquake directly or who only heard it in the news. On 17 August 1999, Turkey experienced a devastating earthquake. Many buildings collapsed in Istanbul, Kocaeli, Sakarya, Bolu, Yalova and Bursa provinces. The earthquake was became a traumatic experience and nightmare for

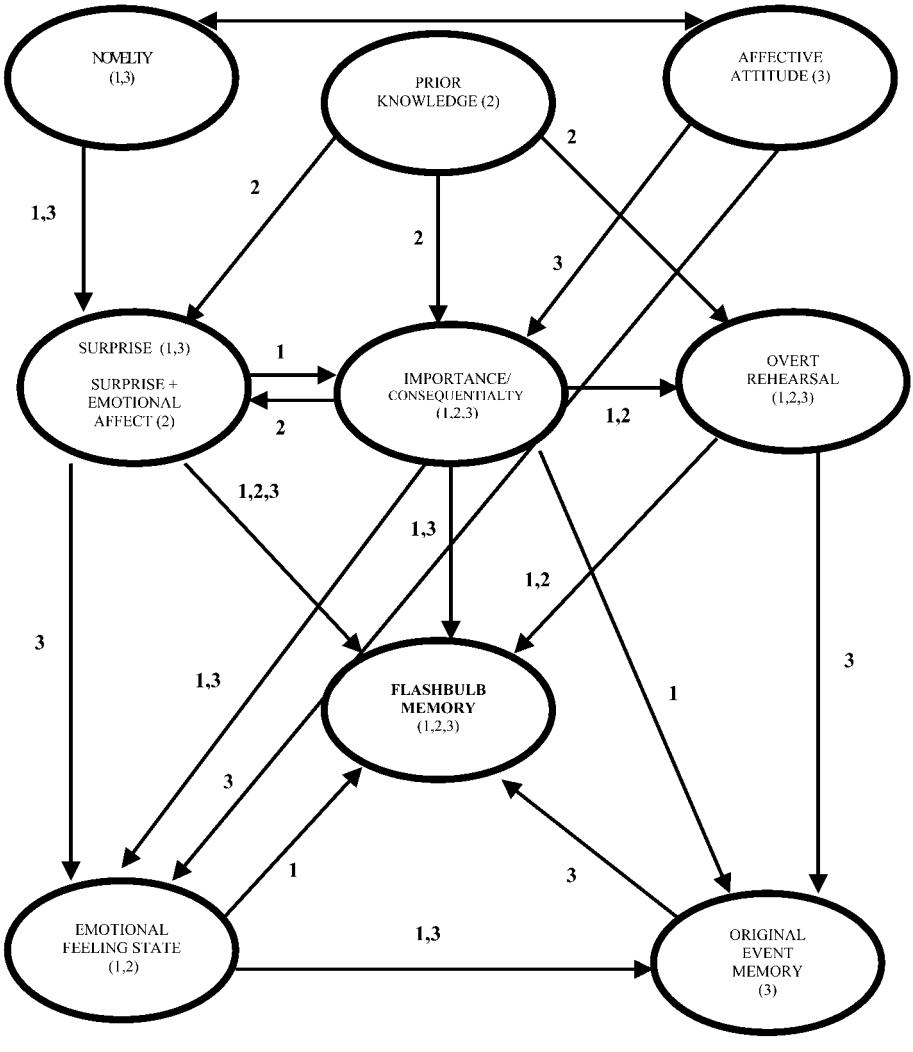

Figure 1. Similarities and differences between the three models of flashbulb memory

Note: 1. The photographic model, 2. The comprehensive model, 3. The emotional-integrative model

people all over the country, as well as for the millions living in the residential areas of the affected towns and city centers. More than 1000 relief workers from 19 countries joined the frantic search for bodies—dead or alive—the day after the quake. According to the Crisis Center in Ankara, the death toll was 15,851 and the reported number of injuries was 43,953.

Since the Marmara earthquake triggered strong emotional reactions and had a serious impact on people from both groups, it is highly suitable to study flashbulb memory. Directly experiencing an earthquake is more stressful and emotional than hearing about an earthquake in the news. In fact, living through an earthquake is an emotionally and personally significant event. Thus, the first assumption of this study is that the recollections of those who experienced the Marmara earthquake will be different from those of the people who had no direct experience. It was assumed that a different flashbulb memory model is needed depending one whether the earthquake was directly experienced or not.

An importance-driven emotional reactions model of flashbulb memory has been proposed. In this model, personal consequences determine intensity of emotional reactions as critical operator in the formation and maintenance of the real flashbulb memory.

METHOD

Participants

A total of 655 Turkish participants volunteered for the study. Of those, 335 (140 female, 195 male) were earthquake victims who experienced the Marmara earthquake directly. The mean age of the earthquake victims was 34.4 ($SD = 14.25$), ranging from 18 to 48 years. The other 320 participants (150 female, 170 male) were from Mersin, which had not been effected by the Marmara earthquake. The comparison group was similar to the victim group in terms of age, gender and education level. The mean age of the comparison group was 30.22 ($SD = 11.19$), ranging from 18 to 53 years.

Questionnaire

A modified version of Finkenauer *et al.*'s (1998) questionnaire was used. It consisted of eight sets of questions investigating different sub-dimensions in the flashbulb memory models: (1) flashbulb memory attributes, (2) original event memory, (3) overt rehearsal, (4) emotional reactions, (5) surprise, (6) novelty, (7) importance/consequentiality, and (8) affective attitude. The questionnaire contained a total of 32 items after the elimination of problematic items in accordance with the results of exploratory factor analysis.

Flashbulb memory attributes

In the questionnaire used for the earthquake victim group, the subjects were asked five questions related to the occurrence of the Marmara earthquake. Similar questions were used for the comparison group, but different from the first group, this time participants answered questions about when they first heard the news: (a) the exact time (they experienced or heard about the quake; *TIME*), (b) the place they were at (city, place, location; *WHERE*), (c) the people they were with (*WHO*), (d) the ongoing activity they were involved in (*WHAT*), (e) for each group, participants were asked to describe up to five specific details of their personal context when they experienced the earthquake or they first heard the news (*DETAIL*). Consequently, flashbulb memory attributes were assessed in terms of five items for both of groups.

The first two items were scored from 0 to 3 according to the number of units subjects recalled. For instance, in the first question, an answer was scored 3 when the exact date was recalled (month, day, hour). The third and the fourth items were scored 1 when respondents were able to remember the answer or 0 when they were not. For the last item, each, of the five specific details was scored to elicit detailed aspects of environment and the subjects' interaction with the environment (see Finkenauer *et al.*, 1998). The maximum score for details was 5. Four independent raters individually examined each detail and scored the last item. Inter-rater reliability was found to be as 0.92.

Original event memory

Original event memory was assessed by using six questions concerning general information about the earthquake that was distributed by the media: (a) the exact time (date:

month, day, hour; *M.TIME*), (b) the number of injured people, dead people, destroyed buildings (*NUMBER*), (c) cities effected by the quake (*CITIES*), (d) reasons for the occurrence (*M.REASON*), (e) help and lifeguard teams (*HELP*), and (f) on duty official improvements (*OFFICIAL*).

All items were scored 0 to 3 according to the number of units, participants recalled. For the last four items, five news reports were selected from the media and among these five, participants were asked how many they recollected. For example, an answer scored 3 when at least 3 news reports were recalled.

Overt rehearsal

Overt rehearsal was assessed by six questions. Respondents were asked to rate how closely they followed the media after the announcement of the Marmara earthquake. On this sub-dimension, respondents were asked: (a) After the earthquake how often they listened the media (*FOLLOW*), (b) how often they talked about the reasons for the occurrence (*T.REASON*), (c) experiences during the quake (*EXPERIENCE*), (d) future plans (*FUTURE*), (e) possible ways of protection from the effects of quakes (*PROTECTION*), and finally, (f) how often they participated in a meeting (conferences, seminars etc.; *MEETING*). All items were rated on a 5 point scale (0 = never, 4 = very often).

Emotional reactions

Emotional reactions to the quake were assessed by six items. In this sub-dimension, respondents were rated according to their level of fright, sadness, desperation, anxiety, and anger. In the last item, subjects were asked to rate how long the emotional impact of the earthquake lasted (*DURATION* of *FRIGHT*, *SADNESS*, *DESPERATION*, *ANXIETY*, *ANGER*) on a 5-point scale (0 = not at all, 4 = very long).

Surprise

Surprise was assessed by three questions. The subjects were asked to rate how shocked they were by the huge number of destroyed buildings (*SURPRISE 1*), the very large number of people injured by the quake (*SURPRISE 2*), and the occurrence of the quake (*SURPRISE 3*) on a 5 point scale (0 = not at all, 4 = a lot).

Novelty

Novelty was assessed by two questions. Participants rated their responses on a 5-point scale. The first item was the extent to which quake was unexpected for them (*UN-EXPECTANCY*) (0 = not at all, 4 = very much), the second was whether they had experienced any quake before or not (*BEFORE*) (0 = never, 4 = three times or more).

Importance/consequentiality

This sub-dimension was assessed by two questions. Respondents were asked to rate how important the quake was for them (*IMPORTANT*), and how much it changed their lives (*CHANGE*) on a 5-point scale (0 = not at all, 4 = very much).

Affective attitude

Respondents rated their affective attitude towards the earthquake victims (*T.VICTIMS*) and volunteer help officers and workers (*T.HELP*) on a 5-point scale (0 = not at all, 4 = strong empathy, for the first item; 0 = not at all, 4 = very grateful, for the second item).

PROCEDURE

Questionnaires were applied by the experimenter to small groups in various temporary camps for the earthquake victims, schools, hospitals etc. Participants were given written instructions and asked to read them carefully. After reading the instructions, they were asked if they had any questions. If they had, the experimenter provided further explanation.

The collection of data took place 6 to 9 months after the Marmara earthquake. Moreover, a small sub-sample of participants from the victim and comparison groups which were given the original questionnaires six months after the event were tested again after a six-month interval.

RESULTS

Four different statistical analyses were carried out to examine the data: (1) descriptive statistics, (2) exploratory factor analysis (3) analysis of variance (ANOVA), and (4) confirmatory factor analysis.

Descriptive analyses

Flashbulb memory

For flashbulb memory attributes, the percentage of personal recall by the subjects in both groups, except on the specific details, was over 90. While 82% of the participants in the victim group recalled all five specific details, the percentage was only 58 in the comparison group. The difference between the two groups was significant ($z = 7.83$, $p < 0.001$). While many people in both groups could recall details of their personal context at the time (whether they experienced the earthquake or heard it in a news reports) a large percentage of the recollections of the participants in victim group were more vivid than the recollection of those from the comparison group.

Original event memory

According to the percentage of correct recall, the earthquake victims generally recalled more accurately than the comparison group in terms of original event memory, but differences observed between the two groups were not significant. Thus, participants from both of the groups had high correct recall of the earthquake-related information that was distributed by the media. More specifically, 76–98% of the participants provided correct answers to six questions concerning original event memory.

Secondary measures

The results showed that the Marmara earthquake had a strong impact on Turkish citizens. Participants reported a high level of fright ($M = 3.92$, $SD = 0.22$), sadness ($M = 3.81$, $SD = 0.14$), desperation ($M = 3.94$, $SD = 0.08$), anxiety ($M = 3.87$, $SD = 0.14$), and anger ($M = 3.90$, $SD = 0.22$). The results indicate that these negative emotions are still being experienced by the participants ($M = 3.69$, $SD = 0.45$). In addition, the participants reported that the Marmara earthquake had a considerable effect on them ($M = 3.75$, $SD = 0.19$), and changed their lives ($M = 3.81$, $SD = 0.21$). They rated the quake as unexpected ('unexpectancy', $M = 3.78$, $SD = 0.23$) and surprising ('surprise 1';

destruction of the buildings, $M = 3.39$, $SD = 0.43$, 'surprise 2'; injuries to people, $M = 3.73$, $SD = 0.56$, 'surprise 3'; occurrence of the quake, $M = 3.56$, $SD = 0.34$). As expected, the incident was very often rehearsed by the participants in different ways. It was rehearsed by following the media ($M = 3.92$, $SD = 0.29$) through conversations about the reasons for the occurrence ($M = 3.85$, $SD = 0.11$), discussion of future plans ($M = 3.23$, $SD = 0.23$), means of protection ($M = 3.55$, $SD = 0.18$), and participation in meetings ($M = 3.02$, $SD = 0.21$).

Exploratory factor analysis

In order to evaluate the extent to which items were loaded on the expected sub-dimensions, exploratory factor analysis was conducted. In general, it was observed that each sub-dimension was represented by items with high loadings. It was found that problematic items, which were identified based on item-total correlations, either had low factor loading or were crossloaded under two or more factors and these problematic items were eliminated. According to the results of the analysis, the questionnaires consisted of 32 items after the elimination of the problematic items. Internal consistency reliabilities for each sub-dimension were also examined.

Confirmatory factor analysis

The proposed structural model in the present study was tested in two stages by utilizing LISREL 8.30 (Jöreskog and Sörbom, 1996). In the first stage, a measurement model was separately tested to see how well the indicators serve as measurement instruments for the underlying latent variables and to examine the correlations among the latent variables in both of the groups. On the basis of modifications for both victims and comparison groups, substantial improvements were observed to fit the data. The final model presented much more satisfactory data for both groups ($\chi^2(94,\ N = 337) = 245.535$, $p < 0.001$, RMS = 0.05, AGFI = 0.92, NNF = 0.94, CFI = 0.95 for the victim group, $\chi^2(96,\ N = 322) = 292.560$, $p < 0.001$, RMS = 0.05, AGFI = 0.89, NNF = 0.91, CFI = 0.92 for the comparison group). In the next stage, the photographic model, the comprehensive model, the emotional-integrative model, and the model proposed in the present study (importance-driven emotional reactions model of flashbulb memory) were compared through the application of structural equation modeling. The fit statistics and comparative fit indices for the victim group are presented in Tables 1 and 2 for the comparison group for all models. To decide how appropriately the model fits the data, the following indicators were used: The lowest ratio of χ^2 to df, the values of the GFI and CFI greater than 0.90 and

Table 1. A summary of fit indices and estimations of the four models in the victim group

	The importance-driven-emotional reactions model	The emotional-integrative model	The photographic model	The comprehensive model
$\chi^2(SD)$	976.25 (336)	1425 (356)	974 (256)	985 (225)
GFI	0.945	0.901	0.881	0.882
AGFI	0.951	0.872	0.852	0.804
CFI	0.967	0.894	0.874	0.865
RMSEA	0.014	0.045	0.063	0.071

Table 2. A summary of fit indices and estimations of the four models in the comparison group

	The importance-driven emotional reactions model	The emotional-integrative model	The photographic model	The comprehensive model
$\chi^2(SD)$	1086 (436)	1255 (456)	985 (325)	1075 (236)
GFI	0.962	0.931	0.903	0.822
AGFI	0.958	0.930	0.891	0.850
CFI	0.984	0.936	0.866	0.864
RMSEA	0.041	0.062	0.089	0.063

the RMSEA value of approximately 0.05 or less (Anderson and Gerbing, 1988; Bollen, 1989).

In this study, a structural diagram for each model was generated but only proposed model's diagram was presented both of the groups (Figure 3 for the earthquake victim group, Figure 4 for the comparison group). Each structural diagram includes relationships between latent (sub-dimensions or constructs) variables and observed (measured) variables. In Figures 3 and 4, latent variables are shown in the ovals and observed variables are in the squares.

As shown in Table 1, the proposed model provided a better fit to the data than the others for the victim group and all the estimated parameters were significant. In this model, the ratio of χ^2 to df and the RMSEA value were lowest and the GFI and CFI values were greatest. Based on the consideration of parsimonious fit, the proposed model seems to be preferable to the others. In Figure 3, according to the structural diagram of the proposed model, flashbulb memory and original event memory are collected under the same construct or factor. In other words, flashbulb memory is the original event memory. Similarly, novelty and surprise are collected under one construct.

According to fit indices for the four models in the comparison group, the proposed model provides an acceptable fit to the data (Table 2). All the item loadings and all of the causal path linking factors are significant. In Table 2, the results were less favourable for the emotional-integrative model, the photographic and the comprehensive models of flashbulb memory compared to the proposed model. As seen in Figure 4, flashbulb memory is different from original event memory in the comparison group, but novelty and surprise are under the same construct like the victim group. On the basis of these analyses, the proposed models (importance-driven emotional reactions models) for the two groups, seem to be an suitable fit to the data.

Consistency of flashbulb memories

Two procedures were applied to verify the accuracy and consistency of flashbulb memories. First, 96 participants from the victim group were married couples who had experienced the quake together. After completing the questionnaires, these couples rated each other's recollections to evaluate their accuracy, noting each specific detail in the last item on a 3-point scale ($-1 =$ inaccurate, $0 =$ I couldn't remember it, $1 =$ accurate). The results indicated 85% of the couples assessed their partner's memories as accurate, 1% of them assessed it as inaccurate and 10% of them couldn't be sure about their partner's answer.

Second, a small sub-sample of participants from the victim and comparison groups were tested twice after the first anniversary of the Marmara earthquake. Eighty participants, 40

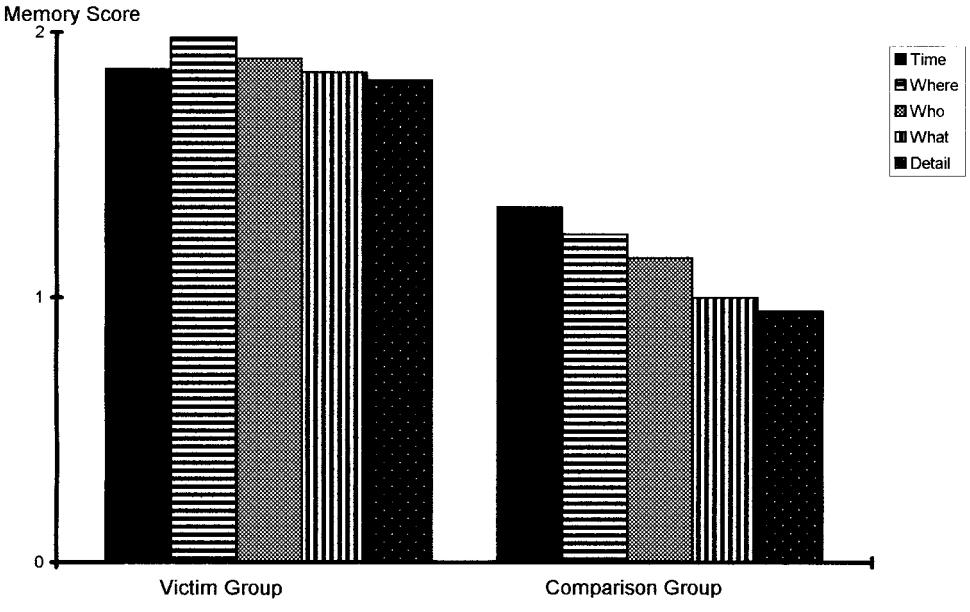

Figure 2. Accuracy scores of flashbulb memory attributes for the victim and comparison groups

(20 female, 20 male) of them from the victim group and 40 (20 female, 20 male) of them from the comparison group participated in the retest. They were selected from participants who had taken the original questionnaires six months after the event. Thus, participants in the sub-sample were retested after a six-month interval. In the retest procedure, participants answered questions only about the flashbulb memory attributes of the questionnaire. It was thought that the answers to the questions from other sub-dimensions might have been influenced by the media and by the lapse of time. To score the retest data, a procedure originally developed by Neisser and Harsh (1992) was used (this procedure was also used in various other studies: e.g. Cohen *et al.*, 1994; Conway *et al.*, 1994; Neisser *et al.*, 1996). All items were scored from 0 to 2 (2 = exactly consistent answer, 1 = not exactly consistent answer, 0 = not completed or inconsistent answer). Three independent judges scored all items and inter-rater reliability was found to be 0.94.

In order to investigate the consistency of flashbulb memories on the sub-sample participants, a mixed model analysis of variance (ANOVA) was conducted on the scores assigned to each of the attributes of memory. In this analysis, the group was a between-subjects variable with two levels (victim and comparison) and flashbulb memory attributes were treated as a repeated measure with five levels (*TIME*, *WHERE*, *WHO*, *WHAT*, *DETAIL*). Results revealed that the main effect of group was the only significant effect $F(1, 178) = 20.12$, $p < 0.001$). In Figure 2, the mean consistency scores for each of the five items in the flashbulb memories sub-dimension are shown for both victim and comparison groups.

According to this result, memory attributes for the comparison group were less accurate than for the victim group. In other words, participants of the victim group were exactly correct on all memory attributes. This finding is particularly important because it shows that victim group recollections were highly consistent in the two testing sessions.

DISCUSSION

The present study was based on the recollections of 335 people who had experienced the Marmara earthquake and 320 people who had had no direct experience of it but had only heard about it on the news. The main findings obtained from this study indicated that the Turkish people had been strongly affected by the event. The findings secondary findings suggested that this disaster generated high levels of surprise, consequentiality and emotional reaction for both groups of people who had experienced or heard about the quake. Participants from both groups rated their emotions at high levels and reported that the Marmara earthquake had a serious effect them.

A comparison has been made between the pattern of accuracy scores for the memory attributes within the victim and comparison groups. The results of the memory attributes data indicate that the Marmara earthquake was accurately recalled and flashbulb memories about the event were consistent after a year. It was reasoned that a different flashbulb memory model was needed, depending on whether an earthquake had been experienced or not. In order to test this consideration, three models previously proposed in the literature and a new model proposed in the present study, called 'importance-driven emotional reactions model of flashbulb memory', were compared through the application of confirmatory factor analyses.

According to results of this analysis, two important similarities were found between the importance-driven emotional reactions model for both groups and the other three models proposed in the literature. First, all four models agreed that importance or consequentiality determined the intensity of the emotional states. Second, rehearsal affected flashbulb memory directly in all models. In the following section, the focus is on the specificities of the importance-driven emotional reactions model for both groups and the implications of this study for the understanding of the nature of flashbulb memory.

IMPORTANCE-DRIVEN EMOTIONAL REACTIONS OF FLASHBULB MEMORY MODEL FOR THE VICTIM GROUP

On the basis of structural equation modeling, the proposed model is more appropriate than the other three models. As seen in Figure 3, all paths linking factors are significant and flashbulb memory is the original event memory. This result is different from the models previously proposed in the literature.

According to this finding, the memories of people who experienced the Marmara earthquake were preserved as a whole and unchanged. Results of the retest show that the long-term memories of the victim group are more complete, more durable and more consistent than those of the comparison group. The findings provide support for the flashbulb and autobiographical memory studies that personal importance is a critical predictor of maintaining clear memories (e.g. Rubin and Kozin, 1984; Wright and Nunn, 2000). Indeed, in the present study, structural equation modelling revealed that importance fires strong emotional reactions and emotional reactions determine flashbulb memory. There is a similarity between the proposed model in this study and the other two models proposed in the literature. The emotional-integrative model (Finkenauer *et al.*, 1998) and the comprehensive model (Conway *et al.*, 1994) assume that personal importance or consequentiality determine the intensity of the emotional state (see also Conway, 1995; Conway *et al.*, 1996). The importance-driven emotional reactions model proposed for the victim group also showed that importance directly affected flashbulb memory formation.

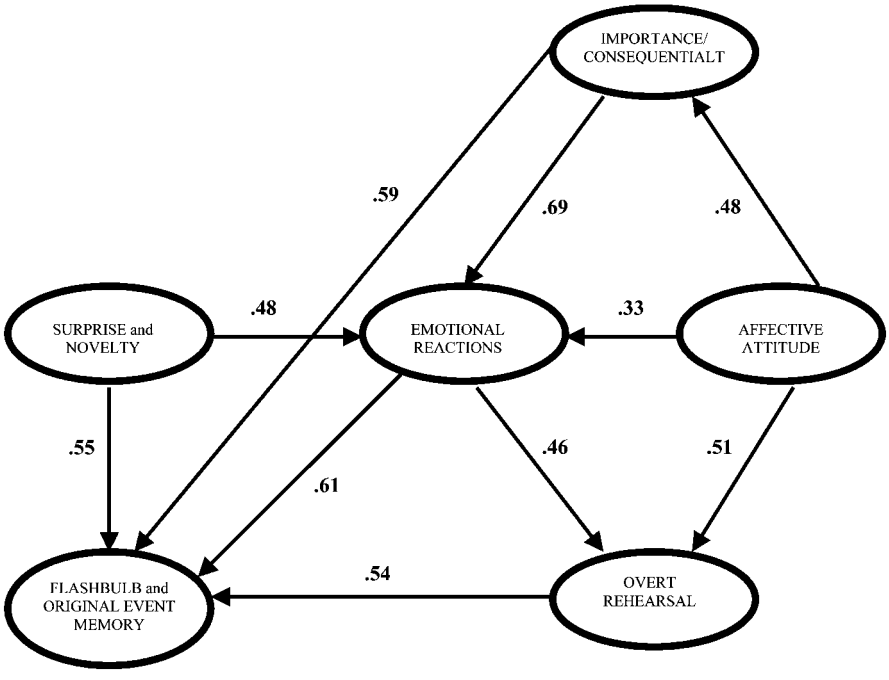

Figure 3. Relations between secondary variables for importance-driven emotional reactions model in the victim group

Note: All of the items loadings and all of the causal paths linking factor are significant

The results show that novelty and surprise are critical factors operating together in the formation of flashbulb memories. All four models agree that flashbulb memories are directly determined by a new or unexpected event. Thus, novelty is a necessary condition for flashbulb memory. This study indicate that novelty and surprise, which are important variables for the flashbulb memory, are under the same construct, and that this construct is directly affected by importance/ consequentiality. Interestingly, people rated the earthquake as something new and surprising even though they had been living in the quake area for a year or more. In the present model, overt rehearsal directly contributes to flashbulb memory formation and maintenance, but this construct is affected by emotional reactions and the affective attitude. Emotional effects, especially in the victim group, have persisted for a very long time. These negative feelings are repeated by way of social sharing (e.g. following the media, conversing about the quake and participating in meetings). Overt rehearsal may lead to accurate flashbulb memories for the victim group by reinforcing the trace of original event memory. This process may be responsible for the finding that flashbulb memory is the original event memory. In other words, since the earthquake is regarded by the people as an important event in their lives, it continues to elicit intense emotional reactions. These negative feelings repeatedly shared by others cause flashbulb memories to remain vivid, detailed and accurate on the basis of the original event. Participants from the victim group who were heavily affected by the results of the quake talked about their experiences excessively.

In Neisser *et al.*'s (1996) study, which investigated memories of the 1989 California earthquake, most Californian subjects who had directly experienced the earthquake

reported their reactions and emotions on the low levels. For this reason, the authors suggested that repeated narrative rehearsals may have played a more important role than emotions and consequentiality. In the present study, participants from the victim group had not only experienced the earthquake directly, but had also been greatly affected by the results. They had talked a lot about all the experiences, just like Neisser *et al.*'s subjects. They had rated their reactions and emotions on higher levels, and they reported that the Marmara earthquake was more important for them than it was for the comparison group.

IMPORTANCE-DRIVEN EMOTIONAL REACTIONS OF FLASHBULB MEMORY MODEL FOR THE COMPARISON GROUP

According to the results of the structural equation modelling, there are some differences between the proposed models for the victim and comparison groups. First, in the model of the comparison group, relationships between latent variables and observed variables, although reliable, are comparatively lower than in the model of the victim group. Second, in contrast to the victim group, flashbulb memory and original event memory are separate constructs in the model of the comparison group. Recollections of subjects who did not directly experience the quake are different from the original event but original event memory has a strong effect on the flashbulb memory. This finding parallels the emotional-integrative model. Third, importance/consequentiality does not directly affect flashbulb memory. Rather, it triggers emotional reactions, which directly determine flashbulb memory. It also affects overt rehearsal.

Finally, as seen from Figures 3 and 4 some processes are common to the formation and maintenance of flashbulb memories for both groups. The critical difference between the two groups hinges on whether the earthquake is directly experienced or not. Therefore, it seems that the processes underlying importance/consequentiality have separate effects on the two groups.

The Marmara earthquake was a nationally publicized event that seriously affected people, yet the results of this event were personal, especially for the people who experienced the quake directly. People have been shocked and surprised by the news of the earthquake and also the event also led to personal consequences for themselves. The present study illustrates that flashbulb memory is event related. If the event is assessed as highly important in their own lives and is associated with a high reaction, then the flashbulb memory is the original event memory. If the importance of the event in their own lives does not reach a critical level, flashbulb memory formed is different from original event memory. In this case, the observed differences between the two proposed models may be due to differences in the importance of the quake in the lives of the people who experienced it. For this reason, these two models have been given the same name: importance-driven emotional reactions model of flashbulb memory.

Flashbulb memory studies often involve the recollections of public events in previous investigations. Perhaps the reason for the decrease in accuracy of memories is the fact that the subjects were not directly affected by the events dealt with in these studies (e.g. Christianson, 1989; McCloskey *et al.*, 1988; Neisser and Harsch, 1992; Pillemer, 1984). Most flashbulb memories study a social psychological phenomenon, how people with little if any personal consequences are affected by public tragedies. The Marmara earthquake, especially for the victim group, is a real flashbulb memory event and has real consequences. The present data all seems to support the conclusion that real personal

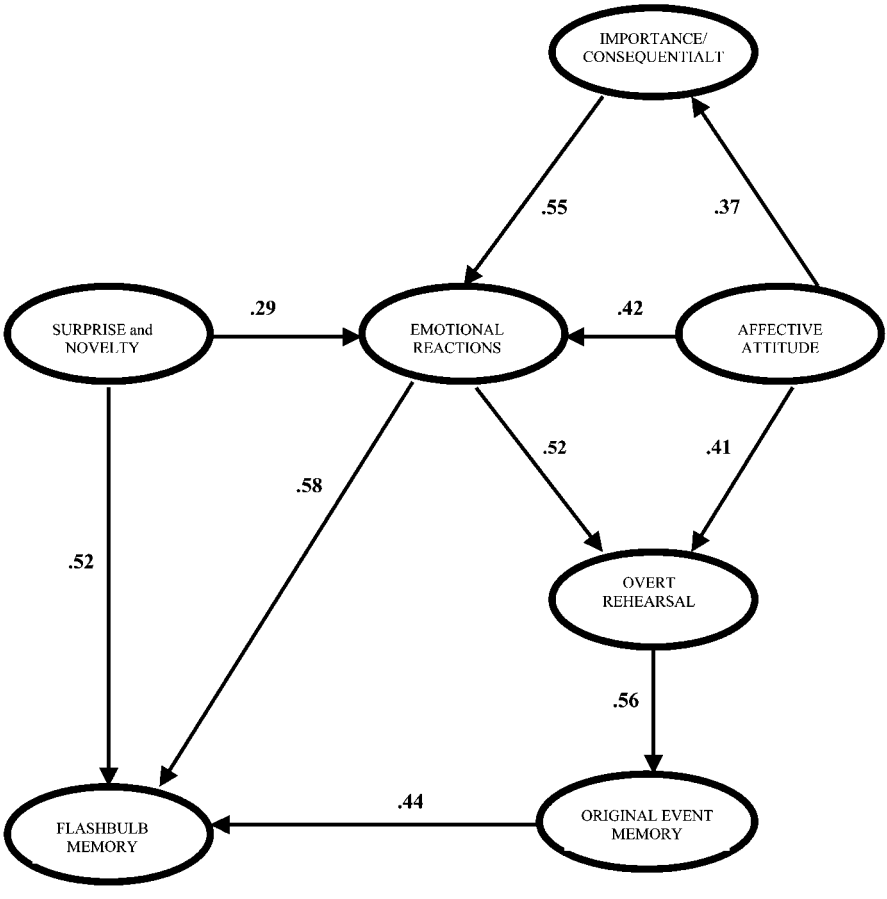

Figure 4. Relations between secondary variables for importance-driven emotional reactions model in the comparison group

Note: All of the items loadings and all of the causal paths linking factor are significant

consequences of the event are served to maintain real flashbulb memories. According to the proposed model in this study, the higher the degree of importance and the more emotional reactions are elicited, the more accurate and detailed the memory. This study sheds some light on the controversy concerning the accuracy of flashbulb memory studies and it also suggests the need for future reseach regarding the way in which people's recollections change depending on whether they experienced the event directly or not.

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