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# The Possibility of Geographic Area and Time Distribution of DRR Education to Represent Disaster Collective Memory: a Time Geographic Study of Newspapers in Japan

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# The Possibility of Geographic Area and Time Distribution of DRR Education to Represent Disaster Collective Memory: A Time Geographic Study of Newspapers in Japan

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**Abstract.** Disaster collective memory is one of the collective memories. Collective memory can appear in a newspaper article. We assumed that disaster collective memory could also appear as DRR education. As people forget about the disaster, DRR education decreases. We examined articles (in a newspaper in one company in Japan) containing the keyword "*DRR education* ([*bōsai kyōiku*] in Japanese)" in the local section. Area names and publication dates were used to identify prefectures and time periods, and plotted on a timeline and in a geographic space. The results showed that the number of articles increased immediately after the disaster, but gradually decreased as time passed. Articles were observed mainly in the affected prefectures, but few were found in the surrounding prefectures. This study suggests that (1) the degree of disaster collective memory (the degree of DRR education) increases immediately after a disaster, but quickly decreases, and (2) disaster collective memory (DRR education) is consolidated in the disaster area but does not easily transfer beyond this region. These findings could be in line with folk beliefs of the difficulty in keeping the memory of the disaster from fading away with time, as well as the challenge of sharing an experience or a lesson with those not affected. Finally, we discuss the limitations and future directions of this study.

**Keywords:** Collective Memory, DRR Education, Time Geography, Newspaper

## 1 Introduction

Collective memory is the memory constructed in a group. Collective memory is not the memory that being constructed in an individual, but several conceptual natures may be shared with the two kinds of memory (e.g., the concept of forgetting, retrieving, encoding). To study collective memory contributes to understanding humans and societies, and these understandings will help to build a better society.

Disaster collective memory is one type of collective memory. After people encounter a tragic disaster (e.g., an earthquake and tsunami like the 2011 Tohoku earthquake and tsunami in Japan), they encode the experience as disaster collective memory. However,

the memory is forgotten over time. We sometimes teach and talk about the experiences to children in order to sustain the memory, but the education and storytelling are conducted less frequently in society as time passes. Finally, the disaster collective memory is completely forgotten.

The study of collective memory has a long history, but looking at it from a psychological perspective is relatively new. Studying disaster collective memory from this perspective is said to be in progress. Recent developments in technology have allowed us to carry out research that was previously considered to be difficult. Data science, which allows us to find patterns and trends from a huge amount of data, can be applied to collective memory research. This study examines disaster collective memory from psychological and data science perspectives.

### 1.1 Collective Memory in Psychology and Data Science

Collective memory has been discussed in various contexts and with various definitions. This study defines collective memory as the memory possessed by a group, not by an individual, as the broadest definition. Recent studies of collective memory have gradually resulted in a growing interest in collective memory in psychology [1, 2, 3]. It would be beneficial to study collective memory by applying psychological theories about individual memory.

The relation between collective memory and the media can be deep. A newspaper is one of the media that reflect people's consciousness and collective memory. A newspaper builds people's minds, and people's minds also build a newspaper. Recent developments in computer technology and the progress of digitization of documents have allowed us to conduct a study with a large database. Searching for newspaper articles containing a certain word, for example, used to be accomplished manually over days or years (or was even impossible), but now can be done with a search engine in a fraction of a minute. We can find people's disaster collective memory in a newspaper, and easily conduct the research with a search engine today.

### 1.2 Relation Disaster Collective Memory and DRR Education

One discussion of handing the culture of the disaster as a memory can be found in a pervious study [4]. This study does not mention it as a collective memory, but the discussion can apply this study. The study examines the trends in fading memories of the disasters and how to prevent this. There are two methods. One is "*disaster for disaster*" and the other is "*campaign*". The former means to experience disaster again (this expression is similar to the classic phrase "*An eye for an eye and a tooth for a tooth.*"). The latter is "*Something reminding people of disaster prevention*". DRR (disaster risk reduction) education at schools and in local communities is one of the campaigns. We can find, as shown below, a relationship between disaster collective memory and DRR education in the same geographic area.

*Enhancement of traffic safety education in a particular area, for example, implies the presence of a tragic accident in that area. This in turn leads to encoding and consolidation of collective memory of the accident (sharing the fact). The education*

*remains for a while and makes any serious accidents no longer happen, but the need of education is no longer found and the memory will be gradually forgotten, and the education will no longer provided. The memory will no longer be retrieved at last.*

The relation between education and memory, as shown above, could also appear between disaster collective memory and DRR education in the same geographic area. Where there is disaster collective memory, there is DRR education, and probably vice versa.

### 1.3 Current Study

Psychological and data science research on disaster collective memory has begun to grow, but there has been little discussion of the relationship between disaster collective memory and DRR education, and there are few empirical studies on the topic. The present study will explore the relationship concerning the rise and fall of the collective memory (DRR education), as well as the areas where the collective memory DRR education is constructed and its spread, by using a database from the newspaper.

Under the assumption that there is a relationship between disaster collective memory and DRR education, and the possibility of finding people's collective memory in a newspaper, we can study people's disaster collective memory by using a newspaper search engine with the keyword "*DRR education*". More specifically, searching newspaper's local sections that include the keyword "*DRR education* [*bosai kyouiku* in Japanese]" and examining the chronological changes of the articles can show how people's disaster collective memory is constructed and forgotten. Plotting the articles on a map by region can also help reveal which regions construct the disaster collective memory as well as whether these memories are being spread.

This study examines a database of Japanese newspaper articles that contains the keyword "*DRR education*" in local sections and investigates chronological changes in the number of articles which regions they are located in (and how they are spread).

## 2 Method

### 2.1 Database and Criteria in Searching

This study examined the local sections of a newspaper published by one Japanese newspaper company (X company). The company is one of the largest national newspaper companies in Japan. The database is available from the newspaper company online. The targeted articles from 1988 to 2020. We have identified articles that contain the keyword "*DRR education* [*bosai kyouiku* in Japanese]" in the local sections. Area names and publication dates were used to identify prefectures and time periods.

### 2.2 Description of Japanese Regions and Mapping

Japan is divided 47 prefectures (see **Fig. 2**). We visualized the geographic distribution the number of articles in **Fig. 2**. The map of Japan was generated in R (version: '4.2.1',

[5]), using the following libraries: *choroplethr* (version: '3.7.0', [6]), and *choropleth-rAdmin1* (version: '1.1.1', [7]).

## 3 Results and Discussions

In total 1,693 articles were extracted. **Fig. 1** shows the chronological change in the number of articles for each year (from 1988 to 2020). **Fig. 2** represents the area distribution of the number of articles in Japan.

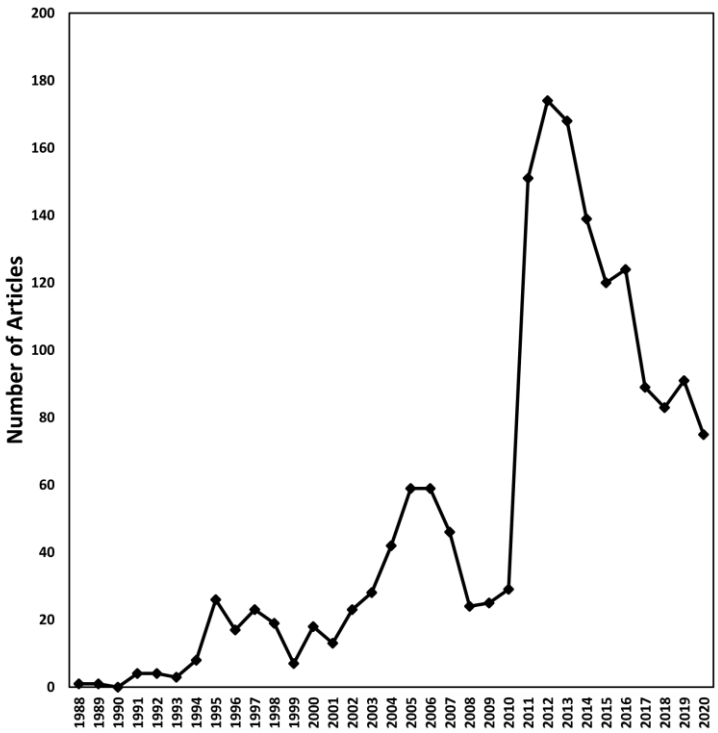


**Fig. 1.** Chronological Change in Number of Articles for Each Year from 1998 to 2020

### 3.1 Chronological Change in Number of Articles from 1988-2020

**Fig. 1** shows that the number of articles increases around 1995, 2005, and 2011. The number decreases after about a one or two years. The first peak in 1995 is the year of the 1995 Great Hanshin earthquake (January 17, 1995; *Mw* = 7.3; number of deaths = 6,434, [8]). The second one in 2005 is the year following the 2004 Chuetsu earthquake (October 23, 2004; *Mw* = 6.8; number of deaths = 68, [8]). The third one in 2011 is the year of the 2011 Tohoku earthquake and tsunami (March 11, 2011; *Mw* = 7.9; number of deaths = 15,900, [9, 10]). Based on these trends, it could be said that disaster

collective memory is formed in the relevant year but is gradually forgotten over time. This kind of forgetting is in line with the decline of individual memory.

It is also assumed that the peak in 2005 is due to the 10th anniversary of the 1995 Great Hanshin earthquake. This possibility is closely related to Japanese culture. A decade is generally considered to be a milestone year, and events and ceremonies are often carried out to commemorate this milestone. This may have contributed to the increase in the number of articles. As this study will focus on observing major trends, we will not discuss this issue further, but a detailed analysis of what the 1995 articles were about will allow us to make a distinction between the influence of the 1995 Great Hanshin earthquake and the influence of the 2004 Chuetsu earthquake.

### 3.2 Area Distribution of Number of Articles between 1988 and 2020

**Table 1** describes the top five prefectures with the highest number of articles. The table includes the number of articles, and whether there were any disasters specified named by the JMA between 1988 and 2020 [11].

**Table 1.** Top 5 Areas in Number of Articles, and Earthquake Named by JMA.

| Prefecture | Number of articles (*k*) | Occurrence earthquake from 1988 to 2020 |
|---|---|---|
| Hyogo | 233 | 1995 Great Hanshin earthquake |
| Miyagi | 140 | 2011 Tohoku earthquake and tsunami |
| Iwate | 123 | 2011 Tohoku earthquake and tsunami |
| Wakayama | 110 | None |
| Kochi | 79 | None |

*Note*. JMA is the Japan Meteorological. JMA give a name to a disaster according to some criteria (e.g., magnitude of earthquake, significant amount of damage, and earthquake swarm; For more detail, see [12]).

The Japan Meteorological Agency (JMA) has established names for natural phenomena that have caused notable disasters. By giving names to the disasters, the JMA hopes to facilitate emergency and restoration activities by disaster prevention agencies and other organizations after a disaster occurs, as well as to pass on the experience and valuable lessons learned from the disaster to future generations. In addition, the names of disasters and the natural phenomena that caused them, which are defined independently in each region, are also to be used and disseminated from the viewpoint of handing down the lessons to future generations [11].

The top three regions in terms of DRR education articles are Hyogo ($k$ = 233), Miyagi ($k$ = 140), and Iwate ($k$ = 123), all of which have experienced a great disaster in the past thirty years (**Table 1**). Of the five regions listed above, Wakayama and Kochi have not experienced any great disasters in the past 30 years, but are expected to have a megaquake in the near future. This may explain the large number of articles on DRR education. The two prefectures have also experienced a large earthquake and tsunami in the past (e.g., October 4, 1707, Hoei earthquake; December 24, 1854, Nankai earthquake), and these ancient earthquakes and tsunamis, combined with the prediction of a

serious earthquake in the near future, may have led to the large amount of disaster education articles, and subsequently to the existence of a disaster collective memory.

**Fig. 2.** Area Distribution of Number of Articles in Japan from 1988 to 2020

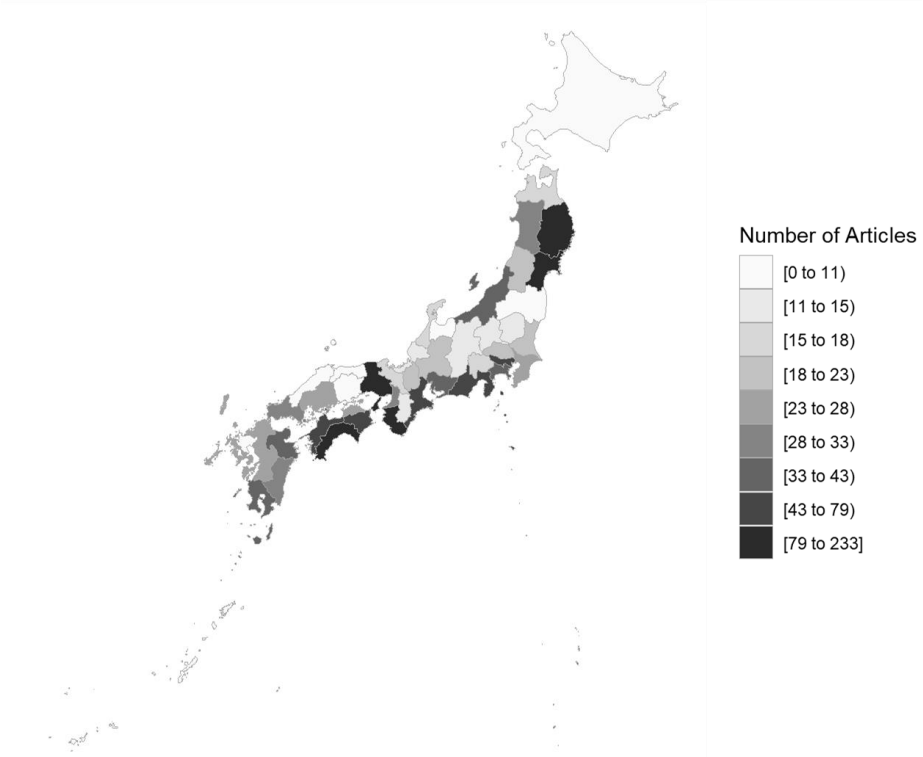


**Fig. 2** describes the distribution and the number of articles. Various discussions can be given by different researchers, but here we focus on the 2011 Tohoku earthquake and tsunami. In the disaster, Iwate, Miyagi, and Fukushima are often highlighted as the affected prefectures. The damage suffered in these areas was large; however, there were few articles on DRR education in Fukushima. Based on the assumption in this study that there is a relationship between DRR education (article) and disaster collective memory, the memory has not been formed in Fukushima. Although it is hard to believe that there is no disaster collective memory in Fukushima at this point, given the nature of the function that DRR education plays in maintaining the collective memory of the disaster, the disaster collective memory in Fukushima will eventually be forgotten. We can say, at the very least, that the disaster collective memory in Fukushima is different from that of other prefectures (Iwate and Miyagi). Disaster collective memory in Fukushima will be a notable topic in the future research.

### 3.3 Limitations and Future Directions

In the following, the limitations and future directions of this study are discussed.

**Combining the Chronological and Regional Factors.** This study has explored only the simplest of analyses. A more detailed study would be beneficial in the following study. By combining the chronological and regional factors, for example, it is possible to investigate collective memory of the earthquake with more dynamism.

**Generalizability.** This study examined one newspaper company in Japan. Future studies should examine other newspaper companies in Japan as well as those in other countries, to generalize the findings of this study. It will be important to examine the generality of this study about disaster collective memory, in the same sense that psychology's goal is to uncover the general laws in human nature.

**Theoretical investigation (top-down approach).** This study investigated disaster collective memory in a data-driven approach, but it could be possible to examine disaster collective memory in a theoretical approach. **Table 2** shows a list of notable earthquakes as named by the JMA (from 1988 to 2020). The table shows that there are indeed a large number of articles about DRR education in prefectures where the number of victims is very significant (Hyogo, Iwate, and Miyagi), as we have discussed above. However, if focusing only on the number of notable occurrences of earthquakes, Hokkaido has the highest number of named earthquakes, in spite of the fact that there are relatively few DRR education articles (see **Figure 2**). What is the reason for that? This may be due to the geographical conditions of Hokkaido, i.e., its vast land. Due to the unique feature of Hokkaido as a vast land, DRR education may remain localized and not be provided as a whole. Consequently, this feature likely influenced the construction of the disaster collective memory in Hokkaido overall. The present approach failed to capture the disaster collective memory in Hokkaido, but is possible that a theoretical investigation could capture that memory. It would be beneficial to further examine theoretical, top-down studies of disaster collective memory, as well as data-driven study like the present study, to develop an understanding of disaster collective memory.

**Relation between Individual Memory and Collective Memory in Theory.** This study defined collective memory as the memory possessed by a group, not an individual. We then discussed the disaster collective memory in terms of encoding and forgetting as it relates to individual memory. Meanwhile, there has also been a discussion regarding retrieval in individual memory study (DRR education in this study is likely to be exactly that), as well as a discussion regarding the types of memories. The most typical types of memory are sensory memory, short-term memory, and long-term memory, but there are other types of memory such as episodic memory, autobiographical memory, and prospective memory. Based on the discussion of the processes and types of individual memory studies, we can advance collective memory (or disaster

collective memory) to bring a broader horizon to the forefront. It would be interesting to examine not only the same conceptual nature shared between individual and collective memory (e.g., the concept of forgetting, retrieving, encoding), but also the differences between them. The nature of memory diffusion (e.g., the concern for the spread of disaster collective memory to other areas in this study) could be an original nature in collective memory. A discussion of the uniqueness of collective memory could be a key challenge for the future.

**Table 2.** List of earthquakes specified by name provided by JMA from 1988 to 2020.

| Area | Period | Name | *Mw* | Number of deaths |
|---|---|---|---|---|
| Hokkaido | January 15, 1993 | 1993 Kushiro earthquake | 7.5 | 2 |
| Hokkaido | July 12, 1993 | 1993 Okushiri earthquake | 7.8 | 202 |
| Hokkaido | October 4, 1994 | 1994 Kuril Islands earthquake | 8.2 | 0[*1] |
| Aomori | December 28, 1994 | 1994 Offshore Sanriku earthquake | 7.6 | 3 |
| Hyogo | January 17, 1995 | 1995 Great Hanshin earthquake | 7.3 | 6,434 |
| Tottori | October 6, 2000 | 2000 Tottori earthquake | 7.3 | 0 |
| Yamaguchi | March 24, 2001 | 2001 Geiyo earthquake | 6.7 | 2 |
| Hokkaido | September 26,2003 | 2003 Tokachi offshore earthquake | 8.0 | 1 |
| Niigata | October 23, 2004 | 2004 Chuetsu earthquake | 6.8 | 68 |
| Ishikawa | March 25, 2007 | 2007 Noto earthquake | 6.9 | 1 |
| Niigata | July 16, 2007 | 2007 Chuetsu offshore earthquake | 6.8 | 15 |
| Iwate and Miyagi | June 14, 2008 | 2008 Iwate–Miyagi Nairiku earthquake | 7.2 | 13 |
| Iwate, Miyagi, and Fukushima | March 11, 2011 | 2011 Tohoku earthquake and tsunami | 7.9 | 15,900 |
| Kumamoto and Oita | April 14, 2016 | 2016 Kumamoto earthquakes | 6.5 | 50 |
| Hokkaido | September 6, 2018 | 2018 Hokkaido Eastern Iburi earthquake | 6.7 | 43 |

*Note*. JMA is the Japan Meteorological. This chart is a list of the earthquake occurrences specified by the name provided by JMA [11]. The area is by authors. *Mw* refers to the magnitude of earthquake. *Mw* and the number of deaths is from additional resources [8, 9, 13]. [*1]At least 10 people killed or missing, many injured and damage on Iturup [14].

## 4 Conclusions

The present study investigated disaster collective memory from psychological and data science perspectives. This study also encompassed a geographical perspective in that the data was plotted in space and time. We hope that future research on disaster collective memory, which is extremely interdisciplinary in origin, will thrive under a variety of collaborations.

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