# Location-based Reminder

## for Memorizing What Visitors Learn at a Museum

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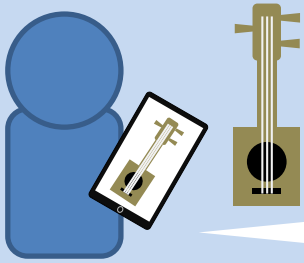
# People easily forget what they have learned

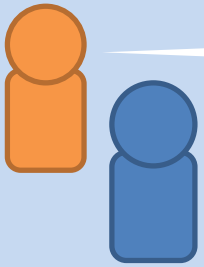
(*e. g.*, internet, books, classes, and **museums**.)

**While you are learning at museum**



**I saw Mongolian fiddle at the museum!**
It is called “Morin khuur”. It’s characterized by its use of animal materials and its animal-shaped form.

**Some days later, in daily life**



What do you know about Central Asian instruments?

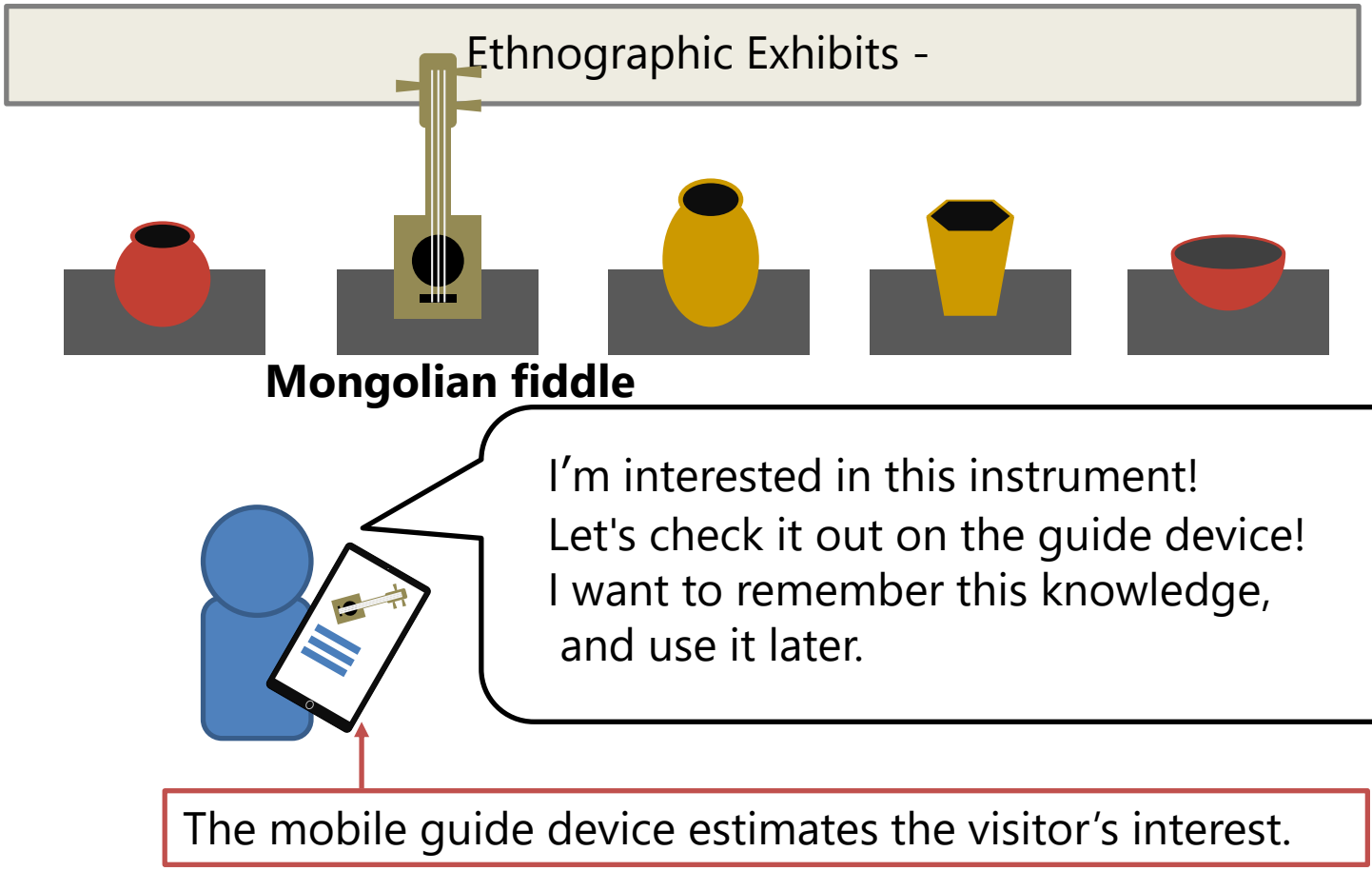
Mmmm… I think I learned it, but I can't remember…

**Museum experiences are extraordinary.**
**Unusual textbook knowledge is hard to remember.**

… How can we connect the museum experience with their daily lives?

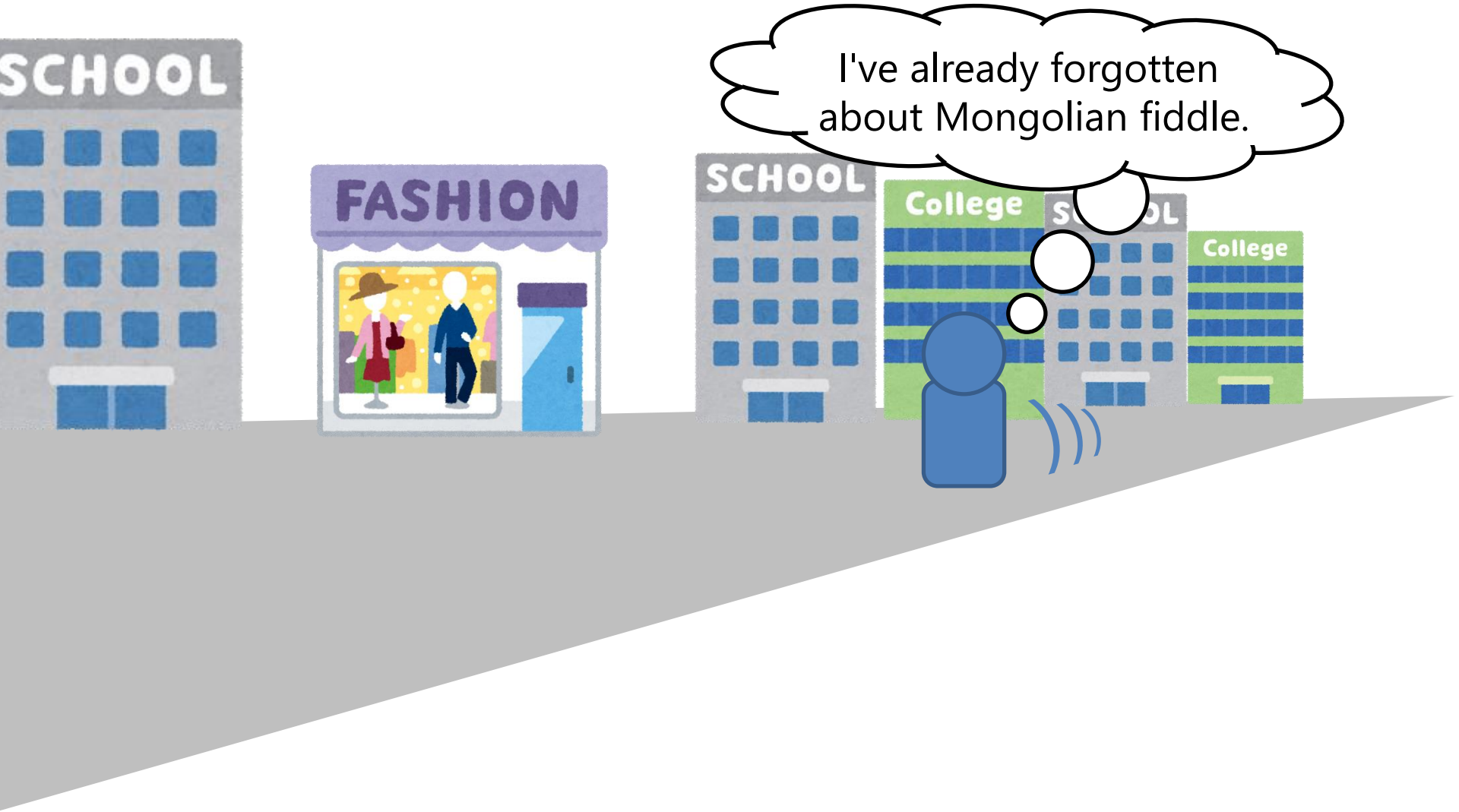
**One day…**

**Visiting museum site with mobile museum guide device**



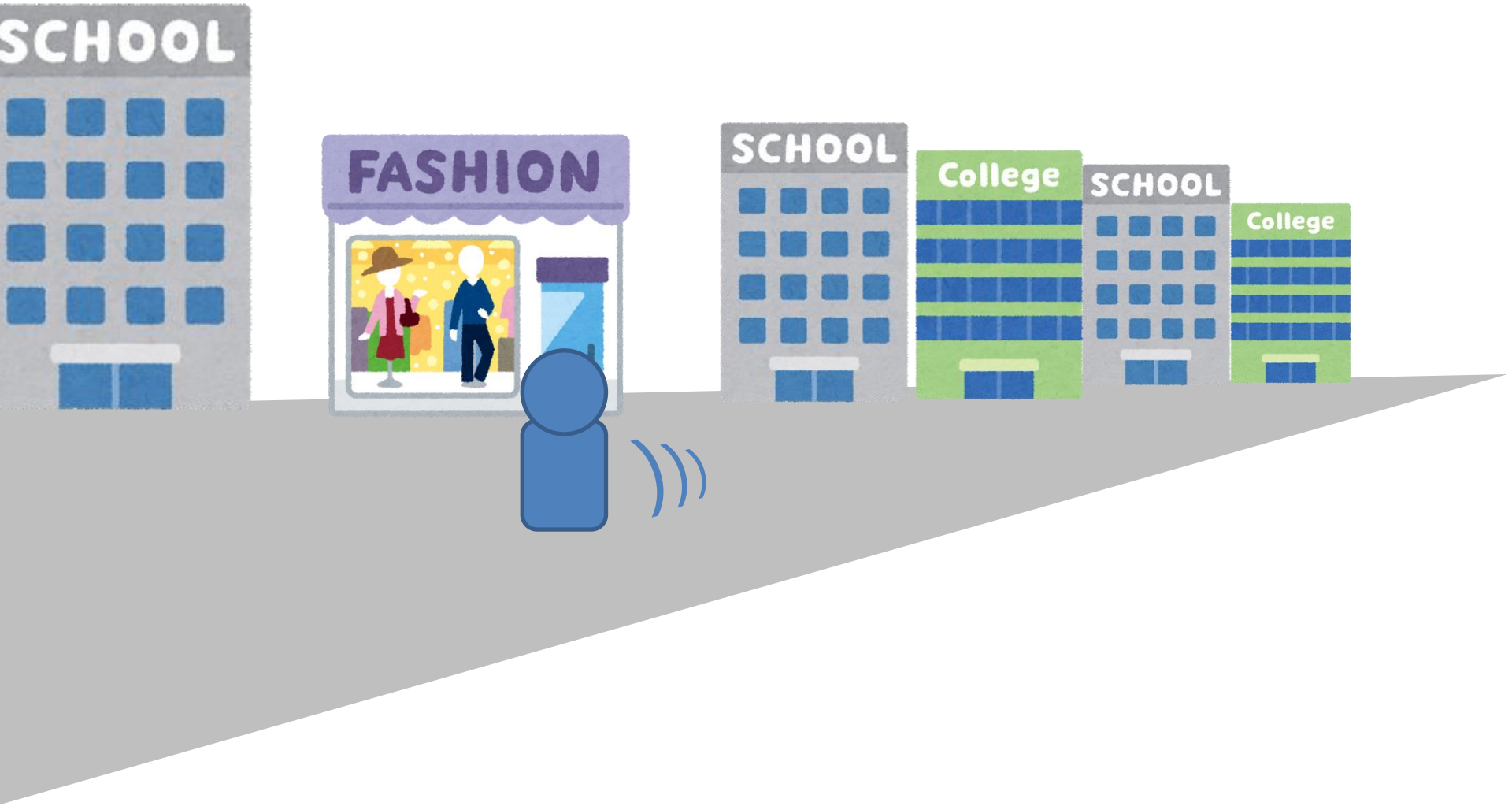
**A few days later**

**In your daily life…**



**A few days later**

**In your daily life, when you accidentally approach a clothing store...**



**A few days later**

**In your daily life, when you accidentally approach a clothing store…**


**Mobile device shows you a reminder notification**

**Notification**

Let's think about
**Mongolian fiddle** right here!

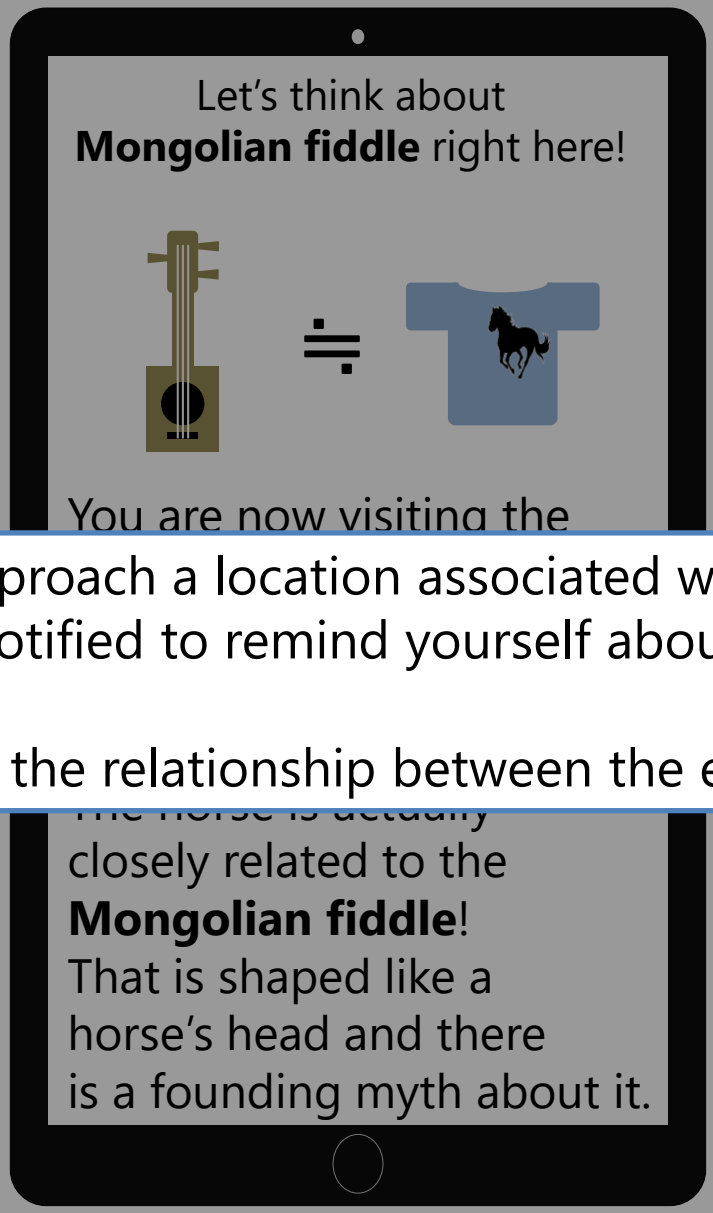
You are now visiting the
**shop of an apparel brand**
that is famous for having
a horse as its logo.

The horse is actually
closely related to the
**Mongolian fiddle**!
That is shaped like a
horse's head and there
is a founding myth about it.

# Proposal: Location-based Reminder for Knowledge Fixation



**Notification**



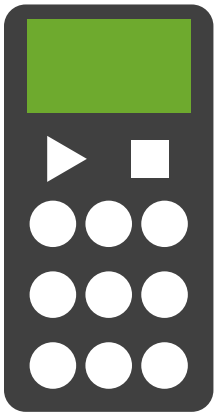

When you approach a location associated with an exhibit,
you will be notified to remind yourself about the exhibit.

The notification tells you the relationship between the exhibit and the location.

# Evaluation of Information Access in Museum



## Evolution of Museum Guide Devices



Traditional Audio Guide

Entrance


Deutsches Museum


Tohaku, Japan

Nowadays Smart Device Guide

**Problem**

How can we evaluate the quality of information access in museums?

**Our idea**

By measuring how much of the visiting experience is retained in the visitor's knowledge.

# Reason Why Focus on Location-based Reminder



**Memory that is linked to personal experience is not easily forgotten.**

Theory in Psychology

**“ Episodic Memories “**

**antonym:** semantic memories (textbook knowledge)

- Memories consist of personal experience
- Easy to remember, but short-term
- Recalled over and over, and turn into long-term memory

Theory in Education

**“ Meaningful Reception Learning “**

Understanding the meaning of things by relating to their experience.

**Example:** field trip in elementary school

Students walk around a city with a teacher after the class.
Teacher introduces objects related to what they are learning in school.
***e.g.,*** the meaning of foreign terms on a signboard can be linked to language learning.

Link knowledge to personal experience to help
fix what visitors learned at the museum into their knowledge

# Technical Challenge: Link Exhibit to Place



We used **Descriptions** in the museum guide app,
and **Reviews** for places in online map site.

## Exhibits

**“Doll of a skeltons playing cards”**

Ethnographic exhibits
Mexican Culture

**【Description】**

In Mexico, skeleton dolls are displayed on the Day of the Dead. Skeletons represent a sense of life and death in Mexico. Dolls are used with sugar candy.

## Places

**【Review】Food market**

Wide parking! I always buy fruits here! Good place.

**【Review】Hardware Store**

I bought a screwdriver here!
All staffs are specialist and kind.

**【Review】Noodle Stand**

Delicious! Salty! I'll be dead by high blood pressure!

**Reviews in Map site**

Extract characteristic terms,
and estimate the degree of relevancy between terms.

# Actual Process for Linking Place and Exhibits



## 1. Extracting Characteristic Terms

extracting characteristic terms from the text of the exhibit's commentary and the place's review,

## 2. Calculate Relevance of Terms

calculating the relevancy between characteristic terms

## 3. Sending Location-based Reminder

Sending notification to their smartphone by using their GPS location and longitude and latitude of shops

# 1. Extracting Characteristic Terms



**Mexican Skeleton Dolls**

Skeleton Dolls is used on the day of the dead Day of the dead is November 2nd, people…

**Japanese Wood Doll**

Kokeshi is a Japanese doll which makes a memorial service for a deceased child…

**Chinese Dragon Doll**

The dragon doll dance is a puppet to ward off evil spirits. In China, it is used during Chinese New Year.

The term **Dead** appeared a few times, but never appeared in other description ➡ characteristic term

**TF-IDF based method:**

Extract characteristic terms of exhibits and reviews by term frequency

# 2. Calculate Relevancy of Terms



**Which is related deeply more?**


How to calculate
the relevancy between
characteristic terms?

## Three Factors for Calculating Relevancy

**F1**: Related terms must appear in the same documents ➡ **Term Co-occurrency** in Wikipedia articles

**F2**: Terms semantically similar are related to each other ➡ **Category Distance** in Wikipedia

**F3**: Combination of terms searched at the same time is popular ➡ **Query Suggestion** in Web search engine

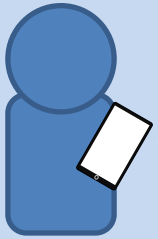
Add up these three scores, and use it as relevancy
Send notification about place with high relevancy to feature words

# 3. Sending Location-based Reminder



**Send notification when the user approaches a location related to the exhibit.**

## Generate Notification Text



You seem to be in front of 【place name】 !
Please think about 【exhibit name】 right here!
This is because… 【snippet of description】
And the review of this location says, 【snippet of review】

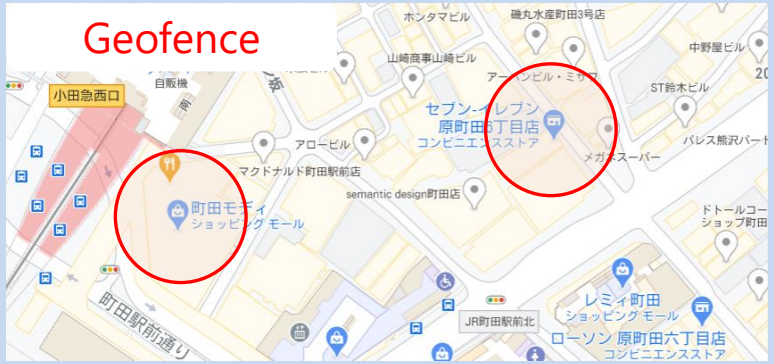
Names of entities

Reason for notification

## Sending Notification to iOS Device

**GeoFence Function**
Notify when a user enters an area

**Local Notification**
Sending reminder without server



# Actual Example of Reminder Notification




**Notified Exhibit**

**Mexican skelton doll**

**Related Place**

**A certain vocational school**

**Reason**

A description of this doll says;
"This doll is used in the day of the **dead**!"

A reviewer said;
"This school is a **prison**!
The teachers are like guards!"

Our system actually reminded about the exhibit when the user approach relevant place.

# Three Subject Experiments for Evaluation



## 1. Accuracy Comparison

Evaluate the relevancy of the exhibit to the location
Which of the three factors worked well?

Comparison by **labeling**

## 2. Comparison Experiment at Laboratory

Evaluate the relevancy of the exhibit to the location
Which of the three factors worked well?

Comparison by **between-subject experiment**

## 3. User Case Study Onsite at Museum

Evaluate the relevancy of the exhibit to the location
Which of the three factors worked well?

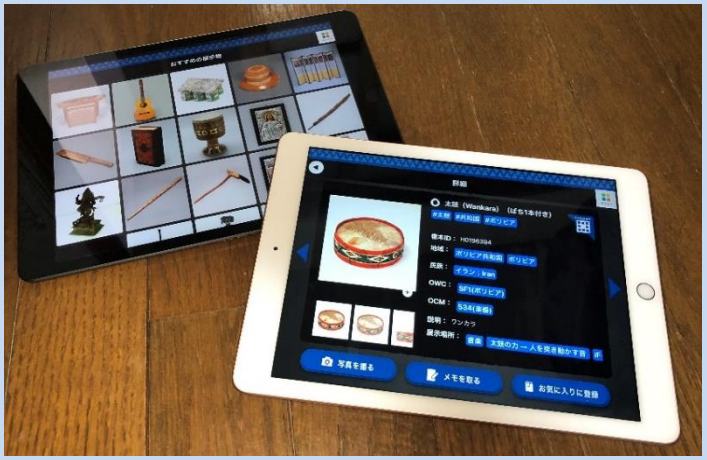
Comparison by **within-subject experiment**

# Dataset for the Experiment



## Exhibits Data: Museum Guide App

iPad App for **Museum of Ethnology in Japan** (Minpaku-Guide).



iPad guide app originally developed by us

Joint research with the National Museum of Ethnology Japan (Minpaku)

Contains information on over 3000 exhibits; Exhibits' metadata, photos, description, etc.

## Places Data: Review data taken from Google Maps

**Collect Review texts by Google Maps Place API**

**Area:** Kobe and West Tokyo, 2km × 2km

**Volume:** 7,500 Places
9,100 Reviews

# Experiment 1： Labeling for the Accuracy Comparison



Method： Labeling task (online survey)


Which Factor is most suitable for calculate relevancy of an exhibit and a review?

Term Co-occurrency (CO), Category distance (Cat), Query Suggestion (QS)

Participants' evaluation result (1 to 4).

| | All | CO only | CO + QS | CO + Cat | Baseline (Doc2Vec) | Random |
|---|---|---|---|---|---|---|
| Relevance | 1.35 | 1.28 | 1.28 | 1.34 | **1.42** | |
| Interestingness | 1.27 | 1.21 | 1.20 | 1.27 | **1.34** | |
| Memorability | 1.24 | 1.23 | 1.22 | 1.25 | **1.32** | 1.23 |

Baseline was the best

Since subjects assessed relevance by simple sentence similarity, the baseline was the best.
On the other hand, combining the three factors resulted in the next highest accuracy

**Inter-subject experiment to evaluate usefulness of the notification**

**1**

- 8 participants used guide app for 40 min. in lab
- Choose 10 favorite exhibits

**Assign the participants to three groups.**

**2** in-City (4)

Go to the city, get notification (60 min)

**2** in-Lab (2)

Stay in the lab, get notification (60 min)

**2** No Reminder (2)

Go home, no notification

**3**


One week later, check if they remember the exhibits

# Result of Experiment 2



**Aim: How Notification Can Help Memory**

**Evaluation Method**： Get notification in city, check memory after 1 week
**Comparison**： in-City, in-Lab, no Reminder
**Participants**： 8 people（4 participants for in-City, 2 for in-Lab, 2 for no Reminder

Number of exhibits they remembered after one week (Max 10, Average of 8 participants)

| | in City | in Lab | no Reminder |
|---|---|---|---|
| # remember w/o hints | 6.00 | **7.50** | 5.50 |
| # remember with **hints** | 0.25 | **2.50** | - |

Asked to “recall the location where you received the notification.”
After that, they could additionally answer remembered exhibits

**Reminding by notification seemed effective for memory retention!**
… But, effectiveness of linking the notification to real places was not confirmed.

# Experiment 3： User Case Study Onsite at Museum 

**Within-subject experiment for user case study**

**1**

- 5 participants visited the Museum of Ethnology
- Select 15 exhibits that they felt interested

**2**

- 1 week later, walk around the city for other purpose
- The notification about 10 of 15 exhibits were sent
- Answer the questionnaire on app usability

**3**


- After 1 week, check what exhibits they remembered
- Compare remembering rate of 10 and 5 exhibits

Average memory rate for 10 notified exhibits and 5 exhibits

| Condition | Rate |
|---|---|
| Notified exhibits | **0.61** |
| Memorizing rate without notification | 0.31 |

Even in the on-site experiments,
the notifications were indeed effective for memory.

# Discussion



## Notification Accuracy

**Quality of the review text is a problem**

Reviews often say things that are not relevant to the location

**Personalization important problem**

Fields in which the subject was originally interested were remembered regardless of the notification

## Comparison at Laboratory

**Task settings was unnatural**

Lent Smartphones, Forced to take a walk

Requires long-term, routine, natural experimental tasks

**Unexpected combinations especially affect memory**

Need to extract unexpected relationships between places and exhibits

## On-site Experiment

**Notification was effective**

Various weaknesses in usability were pointed out

Overall, it seems worked well, but improvement of the method is needed.
Larger-scale and more sophisticated experiments are also needed.

## How Can We Evaluate Information Access in Museum?

**Our idea**

### Memory Retention Rate

By measuring how much of the visiting experience is retained in the visitor's knowledge.

**Evaluation Method**

### Three Experiments

- Simple Labeling Task for method accuracy
- Between Subject Experiment for general evaluation
- Within Subject Experiment for real usability evaluation

**… How should we evaluate the usefulness of museum guide terminals?**

# Summary



| | |
|---|---|
| Purpose | • Location-based Reminder for memory retention<br>• Connect personal experience to actual place |
| Method | • Extract Characteristic terms by using tf-idf<br>• Calculate relevance based on co-occurrence, category and query suggestions |
| Evaluation | • Location-based Reminder for memory retention<br>• Connect personal experience to actual place |
| Result | • Reminders are effective for memory<br>• Need large-scale and sophisticated experiments |