

# The Use of the Word "Through" in an Indoor Environment

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## Abstract

The goal of this preliminary work is to begin to explore the use of the preposition "through" by providing a reflection on its relationship to a specific indoor environment. A user study was conducted where participants gave wayfinding descriptions at the Carnegie Museums of Art and Natural History [10]. These descriptions were then analyzed with a focus on the use of the preposition "through" and how it corresponds to the physical environment. Three types of relationships emerged that appeared to show different associations between the preposition "through" and the physical environment in terms of regions [6] [5] and wayfinding choremes [4]. These groups were: "Through" a neighboring region, "Through" a point of passage, and "Through" instead of "Beside" or "Across." More work needs to be done in this area, particularly in the "Through" instead of "Beside" or "Across" relationship which appears to be quite complex. This reflection hopes to lead to future work that solidifies the relationship between the preposition "through" and how we cognitively conceptualize the indoor spaces it describes [13].

**2012 ACM Subject Classification** General and reference → General literature; Human-centered computing

**Keywords and phrases** spatial cognition, spatial language, indoor environments

**Category** workshop paper

## 1 Introduction

The connection between how a person speaks about a space and their cognitive understanding of it has been established [6] [2] [5] [3] [9] [13]. Of these works, the focus on prepositions as words of importance in spatial cognition are highlighted in [6] and [5] [7] [8]. In addition to prepositions, the study of wayfinding choremes [4] and spatial predicates [7] [8] has also provided a connection between our understanding of a space and the space itself. The focused examination of one preposition can be a worthwhile pursuit as shown in [14] where researchers performed a detailed examination of the preposition "at." Taking these past works into account, the purpose of this work is to further explore the connection between language, cognition, and the actual environment by beginning to reflect on the use of the preposition "through" in one particular indoor environment.

One of the reasons why it is important to study the connection between language and its relationship with our conceptualization of a spatial environment [13] is that it can help to inform the design of computational models of space as well as the usability of spatial information systems [11] [12]. In this study, the word "through" was chosen because it appeared to show three different conceptualizations of space in different areas of a particular indoor environment. While still preliminary, reflecting on the use of the word "through" is a worthwhile conversation that could lead to a further understanding of the connection between language and how we conceptualize an indoor space in information systems.

A user study was conducted that examined the use of the word "through" in wayfinding descriptions and its connection to one particular building. It appears that for the word "through" there are, mainly, three groups of relationships between the preposition "through" and the physical space:

- "Through" a neighboring region
- "Through" a point of passage
- "Through" instead of "beside" or "across"

Although there are many definitions, the definition of the word "through" that will be used in this work is, "...as a function word to indicate movement into at one side or point and out at another and especially the opposite side of" [1]. This paper begins to look at these three groupings within this particular indoor space and how that is related to the language used and the conceptualization of that space [13].

## 2 Methodology

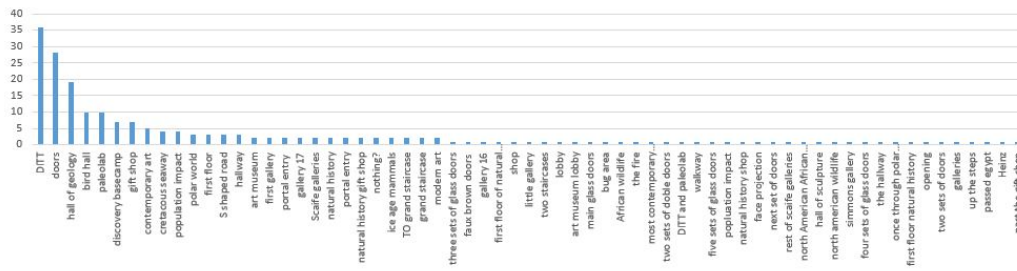
Since this project is an extension of a previous work [10] it is important to discuss how the data was originally collected. In the original work, a user study was conducted at the Carnegie Museums of Art and Natural History in Pittsburgh, PA, USA. Total square footage for the museums is approximately 45,900 square meters. The attendance per year is approximately 330,000 visitors of all ages. The participants for the study were 10 men and 10 women ranging in age from 19 to 77 years. At the time of the study they had been employed at the museums an average of 31.7 months. Participants were sitting in a small windowless room in a private area of the museum that was closed to the public.

After consent was attained, each participant was asked to give 11 wayfinding descriptions from 17 origin and destination locations throughout the museums. They were instructed to give the wayfinding descriptions, "as if they are giving directions to a patron who is not familiar with the environment." Wayfinding descriptions were given in sketch map or verbal form, counterbalanced among participants. Participants did not have access to museum maps during the study. For the purposes of this work, the focus will be on the 154 verbal wayfinding descriptions collected. Each participant was videotaped and wayfinding descriptions were transcribed. From here, each transcription was analyzed by examining the prepositions in the wayfinding description. For the purpose of this work, only the wayfinding descriptions that contained the word "through" were further analyzed. Details and results of this analysis are described in the next section.

## 3 Analysis and Results

In total, 97 of the 154 wayfinding descriptions contained at least one use of the preposition "through." These 97 wayfinding descriptions were further analyzed by examining the areas participants were sending people "through". For example, one wayfinding description contained the verbalization "making a right through the portal entry," so in this case, "the portal entry" was counted and noted. Figure 1 shows the distribution of the number of counts for each area, with most areas being mentioned once or twice. It should be made clear that some data cleaning was performed. For example, "dinosaurs" "dinosaur hall" and "dinosaur exhibition" were all combined into one section. It is clear from the environment, the wayfinding description, as well as the sketch maps from the study that these are all the same area. Any areas that were ambiguous were kept separate.

Since this is a preliminary work, the rest of the analysis focused only on the top five areas where the wayfinding description went "through." The total number of uses of the word "through" for each of these areas is shown in Table 1. This means that Dinosaurs in Their Time (DITT) was the area of the museum said the most after the word "through". After



**Figure 1** The distribution of the counts of the areas that follow the word "through." Most areas are mentioned only once or twice.

that, Doors (of any type), the Hall of Geology, and Bird Hall and PaleoLab were mentioned the most with Bird Hall and PaleoLab tying with ten mentions each.

The analysis of the top five areas began by comparing the use of the word "through" in the wayfinding description, the area mentioned, and the actual environment. As in previous work [7] [8] [4] [13], the focus of the analysis was on figuring out how participants conceptualized these regions of space through their use of the word "through." Figure 2 shows a map of the first floor of the environment, an area where all three types of conceptualizations were represented.

To begin, each of the top five areas from Table 1 were broken down into regions with each named room or area of the museum being a region as shown in Figure 3. Places where one could pass from one region to another were circled in purple. The described path was also shown on the visualization as a purple dotted line. Figure 3 shows the breakdown from the verbalizations, "... through the dinosaurs up to the second floor" as well as "...wind around through dinosaurs in their time.." and "...up the stairs cut through the dinosaurs..."

This type of breakdown was done for each description that mentioned going "through" one of the top five areas in Table 1. When this was finished, it was clear three types of conceptualizations were present: "Through" a Neighboring Region, "Through" a Point of Passage, and "Through" versus "Beside" or "Across." These results are described more below.

### 3.1 "Through" a Neighboring Region

As shown in Table 1, the Dinosaurs in Their Time (DITT) exhibit was mentioned the most as somewhere to go "through" in participant's wayfinding descriptions. The Hall of Geology and Bird Hall were third and fourth respectively. When looking at the map in Figure 2, as well as the broken down map in Figure 3, it becomes clear that one of the reasons why DITT is the most mentioned area after the word "through" may be because it takes up the entire first floor.

**Table 1** The top five locations that participants were verbalizing after the word "through".

Location	Count
DITT	36
Doors (of any type)	28
Hall of Geology	19
Bird Hall	10
Paleolab	10

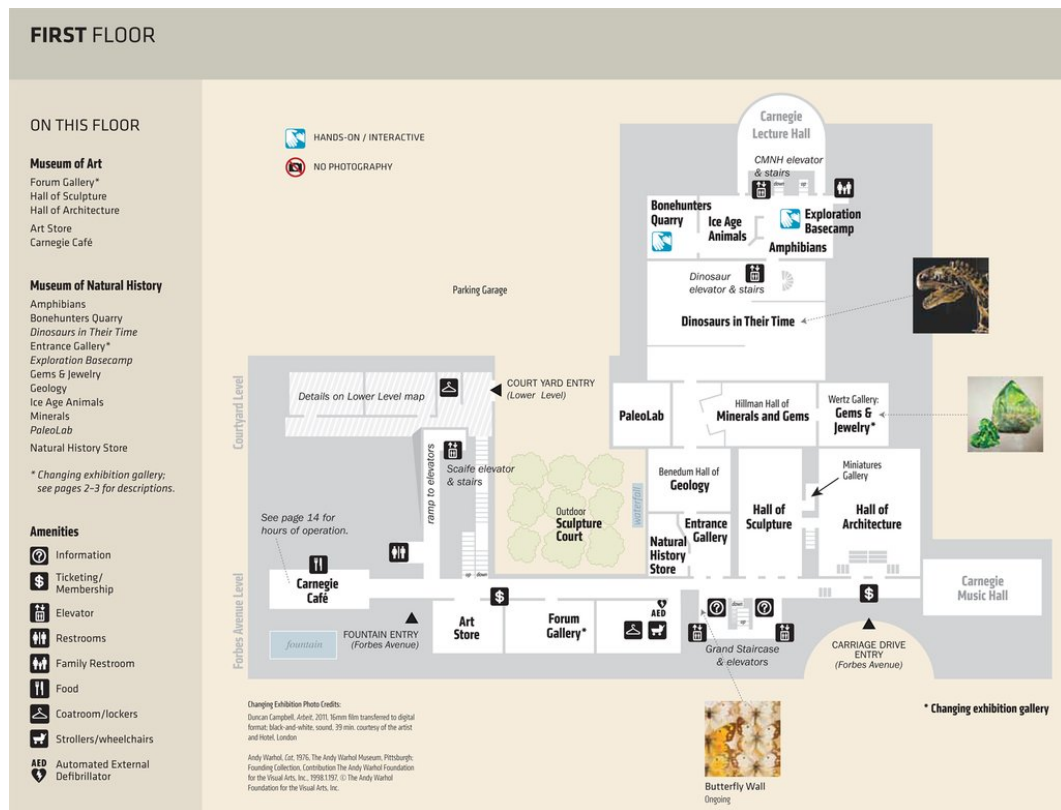
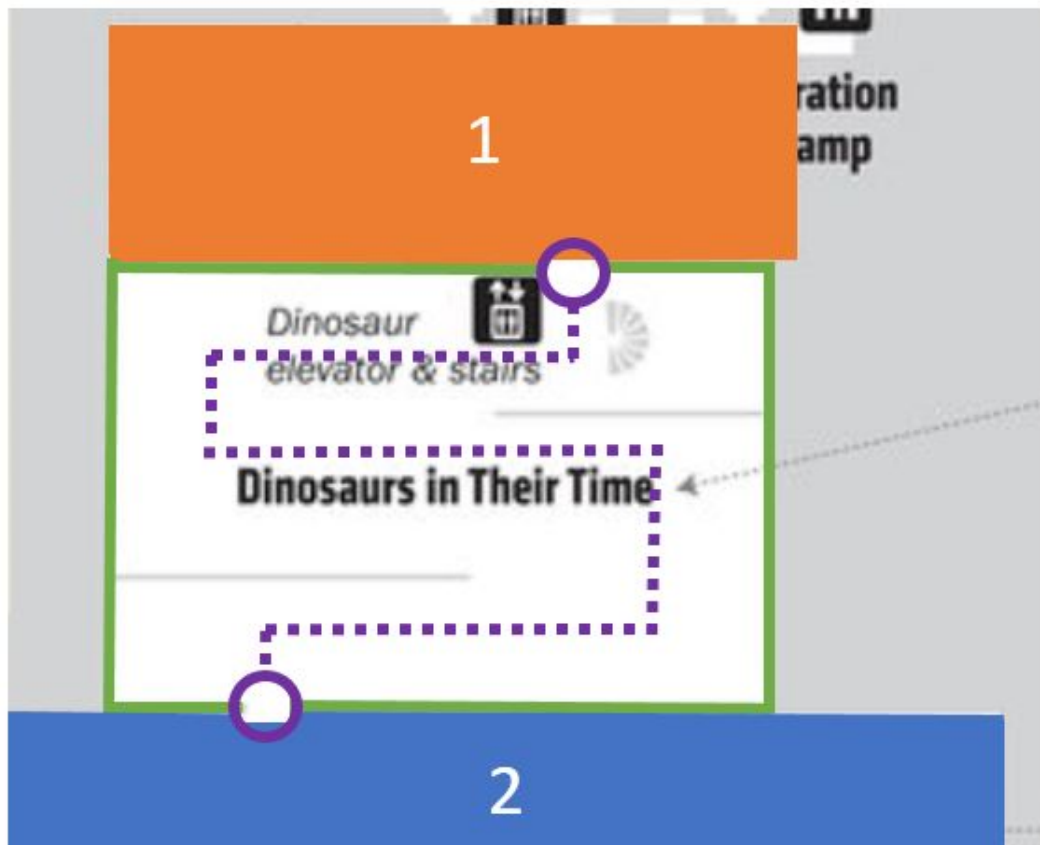


Figure 2 The first floor map of the museum. Dinosaurs in Their Time (DITT) is shown on the top right where the dinosaur fossil is. As you can see from here, it is impossible to cross the museum without going "through" this area.

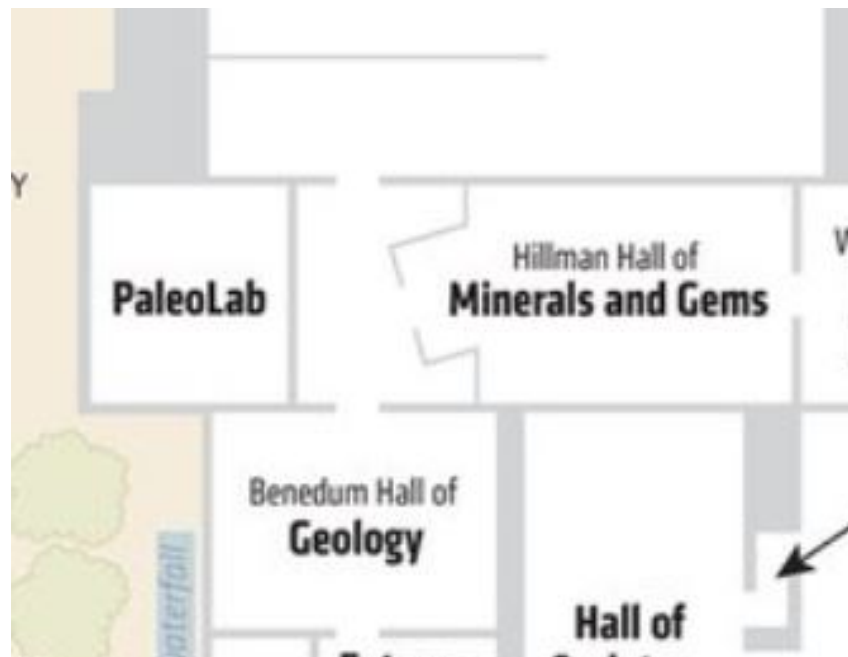


**Figure 3** The area Dinosaurs in Their Time shown as a neighboring region that a participant must enter in order to get from region one to region two. Purple circles show the entrances with the dotted purple line being the path participants gave.

In fact, it would be impossible to reach the other side of the first floor (from region 1 to region 2 or vice versa) without going "through" DITT as shown in Figure 3. Similarly, when examining the map, the Hall of Geology takes up the entire area in that space. It would be impossible to get through this region without passing through the Hall of Geology. Bird Hall, which was the fourth most mentioned area after the preposition "through," has a similar placement in the actual environment, you cannot get to the other side of the museum without going "through" this area.

When thinking in terms of regions [6] and our conceptualization of space through language [13], it would appear that, for these three areas of the museum the word "through" is used because it is between the region you are in and the region you want to get to. In terms of wayfinding choremes [4], it serves as a neighboring region both to the region you are currently in as well as to the region you are trying to get to next. Being a region that is between these areas means that you must go "through" it to continue.

In summary, it would appear that there is a similar relationship between the preposition "through" and the areas DITT, the Hall of Geology, and Bird Hall. When participants are sending people "through" this region of space, they mean that these areas serve as regions that one must go "through" in order to get to another region on the other side.



**Figure 4** A zoomed in view of where PaleoLab is in the museum. From here, you can clearly see that one cannot enter PaleoLab.

### 3.2 "Through" a Point of Passage

The second most popular area mentioned after the word "through" in Table 1 can be thought of as not an area at all, but rather an object. Doors (of any type) were mentioned as necessary to go "through" in wayfinding descriptions. It is important to note here that, for simplicity, all doors were aggregated into one group. In this case, the door appeared to be a way to enter a neighboring region. In terms of wayfinding choremes [4], this appears to be explained by thinking of "the doors" as a point of passage allowing access to the neighboring region.

In summary, there appears to be a relationship between the use of the preposition "through" and Doors (of any type). One explanation can be found in a classification from wayfinding choremes [4] where the door is serving as a point of passage from one region to the neighboring region.

### 3.3 "Through" versus "Beside" or "Across"??

It is easy to understand why participants would give wayfinding descriptions that go "through" a neighboring region or "through" a point of passage, but what becomes an interesting reflection point is shown by examining the PaleoLab area of the museum. Figure 4 shows a zoomed in version of this part of the map. When looking at the map of the environment it becomes clear that, in reality, one cannot enter PaleoLab. In fact, PaleoLab is an observation area where visitors to the museum can watch Paleontologists work on restoring a Mastodon, it is not an area they can go "through" at all. Another feature of the space to notice is that the Hillman Hall of Minerals and Gems is across from the PaleoLab. Why not say to go through the area between PaleoLab and the Hillman Hall of Minerals and Gems? or Across the room after Geology? Another curious point is that participants did not mention going "through" the Hillman Hall of Minerals and Gems at all. Figure 5 shows the relationship



**Figure 5** A view of the PaleoLab and Hillman Hall of Gems and Minerals with regions identified. Purple circles show the entrance and exit of the area and the path that descriptions said to take. Something to note is that green circles show the entrances and exit of the Hillman Hall of Minerals and Gems

between these two areas of the museum in terms of their regions.

In summary, the relationship between the preposition "through" and PaleoLab shows a more complicated conceptualization of space that should be further explored. Why is PaleoLab, an area one cannot actually go "through," always being described as something one can go "through?" Why not across? or beside? Why is the Hillman Hall of Gems and Minerals left out completely?

#### 4 Discussion and Future Work

One possible explanation in the case of the PaleoLab, may be that PaleoLab and the entrance to the Hall of Minerals and Gems is contained in its own area, and when participants say go "through" PaleoLab, they mean go "through" the unnamed room and pass the PaleoLab. This could be a possible explanation since the definition from [1] allows the word "through" to be, "-used as a function word to indicate movement into at *one side* or point and out at another and especially the opposite side of." However, we never enter the PaleoLab itself. Along this line of thinking, the question then becomes what is the relationship between PaleoLab and the area next to it? If we are talking about going "through" the PaleoLab why does the conceptualization of the space communicated with this word not match what is possible in the actual environment? In this case, the idea that wayfinding is an action in motion becomes important [5] [13] and is something that future work may want to explore further.

Another possibility is that the area has been conceptualized as PaleoLab because it is on the left of the map and the map is in English. Perhaps when two areas are across from each other the one on the left becomes the conceptualized space? What is the explanation for why participants chose to call the area PaleoLab and not the Hall of Gems and Minerals?

Perhaps, combining the exploration of the idea of the PaleoLab and the work done in [7] could potentially yield results. Maybe the reason that PaleoLab was chosen was a matter of scale? What does scale look like when we're talking about the conceptualization of an indoor environment? Perhaps the Hillman Hall of Gems and Minerals wasn't mentioned as going "through" because one can *actually go through* this area of the museum. Maybe when we're thinking about areas of indoor environments and how they relate to each other we think in terms of some type of scale?

Future work may also focus on a more thorough analysis of the rest of the data in the study. This study focused on a small subset of data from the original work. Only descriptions

that used the word "through" were analyzed, the original study collected a much larger set of verbal descriptions as well as sketch map descriptions. Perhaps in comparing the sketch map and verbal descriptions we can gain more insight into the use of the word "through" and the way that we conceptualize spatial structures.

Another area of study could potentially be in the inconsistency in the use of the word "through" in this data set as a whole. When looking at the distribution of the areas that participants were instructing people to go "through" in Figure 1 it becomes clear that the majority of the areas were only mentioned once or twice. This means that, in general, there were very few descriptions where every one of the 11 participants said to go "through" a specific area. Future work may want to examine why other words were chosen to conceptualize the space? Is the calibration of these terms different when we're talking about indoor space? [8]

Lastly, more work lies in the application of the results presented in this work. One area that could greatly benefit from the future work based on this reflection is the area of Natural Language Processing. These insights could potentially be made into something like [11] where computational models are bridged with what we know about how people think about their space. Fully understanding how language conveys our conceptualization of space is well studied beginning with Talmy's seminal work [13] (citation is a new edition), but how we can apply these concepts in today's world of voice controlled technology is another area of great potential. In addition to NLP, the improvement of spatial information systems that are focused on indoor environments such as [12] is another space that could be improved with more understanding of the conceptualization of indoor space. Being able to provide insight into bridging the gap between language, cognition, the actual environment, and the tools that we use to find our way in these environments would make these tools more salient and usable.

## 5 Conclusion

In conclusion, the purpose of this work is to further explore the connection between language, cognition, and the actual environment by beginning to reflect on the use of the preposition "through" in one particular indoor environment. This preliminary reflection presented three possible relationships between the preposition "through" in wayfinding descriptions and the actual environment in this study. The first is "Through" a Neighboring Region which means that the word "through" is used because the region lies in the way of the region you are in and the one you are trying to get to. The second use of the word "through" was seen when it was paired with a door. In this case, the door served as a Point of Passage from one region to the neighboring region.

However, an unclear relationship emerged between the preposition "through" and the physical environment when studying the PaleoLab. It would appear that there is some sort of relationship between PaleoLab and the physical space it occupies. Participants often used the preposition "through" to describe a route one can't actually go through. The relationship between PaleoLab, the physical environment, and the preposition "through" is a puzzling one that deserves more study.

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