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DEFAULT REFERENCE FRAMES OF CHILDREN AND ADULTS:
DEVELOPMENT OF THE CONCEPT OF PLACE IN LANGUAGE

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A pervasive activity in human language and thought is the breaking up of what is essentially a continuous spatial world into discrete units or places. When describing objects or events, we constantly make distinctions between those occurring in the "same" place vs. those occurring in "different" places, a distinction that requires the categorization of space into discrete places: "One may (...) perceive the 'foreground' of an unbroken landscape (...) It is commonplace that in human perception many entities exist, like the place in a continuous expanse of lawn where a flowerbed is to be put in, such that no sensory delimitation of figure from ground can even be suggested. The 'corner' of a room certainly does not always refer to a geometrical point (...) Its locus is sensorily [*sic*] fixed, but not its boundaries, and language is full of terms with a similar implication for the theory of perception"(1).

However, the bases for these distinctions are not always obvious and unambiguous, and the distinctions often shift radically depending on the context in which they are made. For example, depending on the context of communication, two people sitting in a conference room may be said to be in the same place or in different places. This paper explores some of the bases for such spatial categorizations, and how they may differ in children and adults. The question of how people subjectively partition their spatial worlds into discrete units is of interest to many design and research professionals, including psychologists, architects, planners, linguists, geographers, and, of course, semioticians.

When the classification of events and objects as being at the same place or at different places is based on spatial information of some type, the use of a point or frame of reference is required (as when any spatial information is

1 D. HEBB, "Organization of behavior", John Wiley & Sons, New York, 1949, p. 21-22.

called for that is more than merely topological(2)). As such, this classification is an example of spatial deixis in language(3): its correct interpretation involves a reference to some type of spatial origin point or reference frame. For instance, to correctly interpret the statement, "the microphone is here", one realizes in this context that "here" refers to near where I am standing and not to this room or this city. The research described below takes as a premise that the way objects or events are spontaneously classified as occurring at the same or at different places will tell us something about the spontaneous or default use of reference frames in spatial thought and spatial language. It is "default" because no particular reference frame is required by the descriptions used in the research.

Recent work(4) has focussed on the "mental models" or "world models" that people use to interpret narrative texts. This idea suggests that people follow texts, and extract their meaning, by constructing mental images or models that represent the spatial environments, objects and events described in the text (in addition to representing some schematic information that was not actually described in the text). The correct interpretation of textual references to space (e.g., "here", "there", "in the same place") requires that the reader construct and categorize spatial units as the author intends. This work on text interpretation suggests that the categorization of space may be relevant to both linguistic and nonlinguistic cognition for some of the same reasons. Work on direction-giving in communication(5) leads to a similar conclusion(6).

2 J. PIAGET, B. INHELDER, "The child's conception of space", Norton, New York, 1956.
H. PICK, J. LOCKMAN, "From frames of reference to spatial representations", in L. LIBEN, A. PATTERSON, N. NEWCOMBE (Eds.), "Spatial representation and behavior across the life span", Academic, New York, 1981.

3 K. BÜHLER, "The deictic field of language and deictic words", in R. JARVELLA, W. KLEIN (Eds.), "Speech, place, & action", John Wiley & Sons, Chichester, New York, 1982.

4 G. BOWER, D. MORROW, "Mental models in narrative comprehension", Science, 1990, vol. 247. P. JOHNSON-LAIRD, "Mental models", Harvard University, Cambridge, 1983.

5 W. KLEIN, "Local deixis in route directions", in R. JARVELLA, W. KLEIN (Eds.), "Speech, place, & action", John Wiley & Sons, Chichester, New York, 1982.

6 For work on linguistic descriptions of apartment layout, see C. LINDE, W. LABOV, "Spatial networks as a site for the study of language and thought", Language, 1975, vol. 51.

Of course, studying the development of deixis and spatial categorization from childhood to maturity (ontogeny of spatial categorization) should help explicate some of the cognitive processes involved in such decisions. There is a large literature on the development of spatial cognition(7). Although there is literature dealing with deixis in children, especially the use and knowledge of locative prepositions(8), there is not much on the natural categorization of space into places(9).

A couple of developmental predictions come from Piaget's important work on the development of spatial perception and cognition. One is that children who do not organize space around abstract, Euclidean reference frames (younger than 10 years or so) should be influenced more by changes relative to local reference frames (such as the room one is in) than by changes relative only to global frames (such as the earth). Another prediction is that pre-formal operational thinkers (younger than 12 years or so) may be rather concrete and rigid in their categorizations of space. As such, these children should tend to unambiguously describe objects or events as occurring at the same or different places without much appreciation of the ambiguity and relativity of these judgments. Samples of both 10-year olds and college-age adults are included in the study described below in order to test these hypotheses about the use of geocentric frames and about tolerance for spatial ambiguity. The inclusion of a sample of children may also help illuminate other factors involved in making place distinctions.

What are some of the contextual factors that influence the way place distinctions are made? A variety of contextual

7 R. HART, G. MOORE, "The development of spatial cognition: A review", in R. DOWNS, D. STEA (Eds.), "Image and environment", Aldine, Chicago, 1973. C. SPENCER, M. BLADES, K. MORSLEY, "The child in the physical environment: The development of spatial knowledge and cognition", John Wiley & Sons, Chichester, New York, 1989.

8 e.g., J. JOHNSTON, "Children's verbal representation of spatial location", in J. STILES-DAVIS, M. KRITCHEVSKY, U. BELLUGI (Eds.), "Spatial cognition: Brain bases and development", Lawrence Erlbaum, Hillsdale, 1988.

9 For work on pattern separation and same-difference judgments, see A. NICOLOPOULOU, "Interrelation of logical and spatial knowledge in preschoolers", in J. STILES-DAVIS, M. KRITCHEVSKY, U. BELLUGI (Eds.), "Spatial cognition: Brain bases and development", Lawrence Erlbaum, Hillsdale, 1988.

sources will influence linguistic interpretation(10). The research described in this paper uses several short vignettes or stories that describe a person doing something or being somewhere at two different moments in time. These stories (presented below) vary several elements of context that may be relevant for making place discriminations:

(a) time--the amount of time passing between the two target moments, and whether the two moments are part of one continuous episode; (b) movement--whether any movement occurs, how much movement, and whether it is body locomotion relative to local surrounds (local frame) or only relative to the earth (geocentric frame); (c) characteristics of the space--whether something about the nature of the local surrounds changes, and whether the person is within physically bounded, inside spaces or unbounded, outside spaces at the two moments asked about; (d) characteristics of the intervening event--whether the event described in the story is common, whether it is readily reversible, and whether a few or many people are influenced by the event.

1. The study and results

Eighty-two college students and 51 10-year old children were presented with eight stories of varying ambiguity about a person being at a certain place at two separate moments. Some type of event typically intervened between the two moments. Subjects were asked to decide whether the person was at the same place or different places at those two moments and to provide a rationale for their decision. Adults responded in writing; children responded orally into a tape recorder. The eight stories (which were presented in random orders) are given below. Along with each I give the percentage (%) of adults or children who responded that the person was at the same place, different places, or the same place or different places depending on what one refers to in the situation (ambiguous response):

1. One day, Billie is standing in his bedroom looking out the window. Then he turns around and looks at the door.

10 M. HALLE, J. BRESNAN, G. MILLER (Eds.), "Linguistic theory and psychological reality", MIT, Cambridge, 1978.

Is Billie in the same place or a different place at those two times?

Same Different Ambiguous

Adults 84% 11% 5%

Children 86% 14% 0%

2. One day, Marie is standing in her bedroom next to the desk. Then she walks over to the dresser and stands there. Is Marie in the same place or a different place at those two times?(11)

Same Different Ambiguous

Adults 7% 70% 23%

Children 10% 84% 6%

3. One day, Julie goes to the store with her Dad. Before they leave for the store, she is sitting in the backseat of her dad's car while it is parked in the driveway. After they get to the store, she is sitting in the backseat while her dad goes into the store. Is Julie in the same place or a different place at those two times?

Same Different Ambiguous

Adults 29% 45% 26%

Children 47% 39% 14%

4. One morning, Frankie is standing in his house next to the bathroom sink. Later that day, movers come with trucks and pick up Frankie's house and move it to the other side of the street. That evening, after the house is moved, Frankie is standing next to the bathroom sink again. Is Frankie in the same place or a different place at those two times?

Same Different Ambiguous

Adults 16% 54% 30%

Children 30% 52% 18%

5. One day, Ralph is standing next to his desk. That night, after he has gone home, Ralph's school burns down. The next day, after his school has burned down, Ralph is standing next to where his desk used to be. Is Ralph in the same place or a different place at those two times?

Same Different Ambiguous

Adults 68% 18% 14%

Children 72% 20% 8%

11. Statistically reliable differences between adults and children.

6. One day, John is in an airplane as it flies over San Francisco Bay at 20 thousand feet. The next week, he is in the same seat in the airplane as it again flies over San Francisco Bay at 20 thousand feet. Is John in the same place or a different place at those two times?(11)

Same Different Ambiguous

Adults 72% 22% 6%

Children 90% 10% 0%

7. One evening, Kimmy is sitting in her chair in an orbiting space station above the Indian Ocean. Several hours later, she is still sitting in her chair in the space station as it travels over the Atlantic Ocean. Is Kimmy in the same place or a different place at those two times?

Same Different Ambiguous

Adults 22% 49% 29%

Children 16% 63% 22%

8. One day, Wilma is standing next to the kitchen sink in her house. Later that week, when she is not at home, Wilma's house is torn down and a new house is built at the same address with a kitchen where the old kitchen was. The next month, she is standing next to the kitchen sink in her new house. Is Wilma in the same place or a different place at those two times?

Same Different Ambiguous

Adults 65% 27% 8%

Children 54% 36% 10%

The fact that there is so much variability in these patterns of responses, even for adults, indicates that decisions about place identity in the stories were not obvious and unambiguous to subjects, for the most part. Both adults and children paused, changed answers, and exclaimed frustration during the task. For each story, one of each of all three possible responses was given by at least a few subjects (with the exception of no children responding "ambiguously" to stories 1 and 6). For both adults and children, only in the case of story 1 was there as much as 80% agreement about Billie being in the same place after turning around. Seventy percent of adults and 90% of children also agreed that John was in the same place after flying over the Bay twice. There was little agreement about any of the stories depicting someone in different places, though 70% of adults and 84% of children did agree that Marie was in a different place after walking over to the dresser. There were a sizeable number of "ambiguous" responses, especially for stories 2, 3, 4, and 7. The results show, however, that ambiguous responses were more common among adults than children. Adults gave almost 1

and 1/2 ambiguous responses per person on the average, but children gave less than 1 ambiguous response per person, a statistically reliable difference.

Other than this difference, the patterns of responses were similar for adults and children. The only stories for which the patterns of responses reliably differed for the two groups were two that a large majority of subjects within each group agreed about, stories 2 and 6. Adults did not agree as strongly that Marie was in a different place after walking over to the dresser; several more responded ambiguously to that story. Adults also agreed less strongly about John being in the same place after flying over the Bay again; several more said that he was in a different place, or that the question was ambiguous.

2. Discussion and conclusions

Distinctions between objects and events occurring at the same place and those occurring at different places are very common in our thought and our language. The research described in this paper is an initial attempt to clarify this aspect of the psychology of space and spatial meaning. The results indicate that the distinction reflects interesting and nontrivial aspects of this psychology.

Are there particular contextual elements of situations that seem to be related to the way people make this distinction? Several are suggested by the patterns of responses to the stories described above. Most evident is the tendency, even by 10-year olds, to define "place" relative to location on the earth's surface. A majority of subjects said the persons in the stories were at the same place when their locations were the same relative to the earth at the two moments asked about (stories 1, 5, 6, and 8). This was true even when the location was inside a building at one moment and outside in a pile of rubble at another (story 5). In response to the other stories, in all of which a different location relative to the earth was obtained, subjects said the persons were in different places most often. This was true even when the change of location was only a few feet inside a room (story 2) and when the persons' locations within the immediately surrounding and unchanging environment did not change (stories 3, 4, and 7). One precocious 10-year old even referred to a galactic or universal frame:

"...the earth orbits around the sun and it turns...if you were sitting in the same place, you'd be in a different spot every hour"

However, many subjects did feel the question was ambiguous when stability within local surroundings was contrasted with movement relative to the earth (stories 3, 4, and 7), suggesting the occasional influence of a local frame.

Passage of time, episode continuity, the presence or absence of movement per se, the nature of the movement, characteristics of the surroundings at the two moments, and characteristics of the intervening event all had relatively small and inconsistent effects on subjects' tendencies to ascribe the persons in the stories same or different place locations. But there were interesting cases, most commonly by adults, of non-spatial or non-positional justifications being given for place distinctions. On story 1, 10 adults and 5 children said Billie was, or might be, in a different place because his view was different after turning around. On story 5, 17 adults and 6 children said Ralph was, or might be, in a different place because there was no desk, roof, or building after the fire. On story 6, 7 adults said John was, or might be, in a different place because of the passage of time on his second flight. On story 8, 13 adults and 15 children said Wilma was, or might be, in a different place because her new house was a new building. In a few other cases on various stories, adult subjects said that the characters in the stories were in different places because of a change of affect, thoughts, memories, or experiences.

Some interesting examples from adult subjects:

Story 1: "Billie is in a different place. He is facing a different direction -- seeing different stimuli."

Story 5: "Ralph is at the same place. Although the conditions that create a definite sense of reality, the school, are gone, the memories of all the objects still pervade. Place, then, has to do with each individual and to circumstances evolved in consciousness."

Story 5: "Different. Does Ralph have the same affect at both times he is standing by his desk? Need I say more?"

Story 6: "Same. Because all of the air in the world runs together."

Story 6: "Different. Because to be in the same location on the same airplane would be a travel agent's nightmare!"

Besides the increase in non-spatial or non-positional justifications for place distinctions exhibited by adults, there was not much evidence for developmental progression in the making of

place distinctions. The other exception was the increased likelihood for adults to respond ambiguously (though by no means did children completely fail to do so). Besides these differences, there was only a very slight tendency for the children to focus more on local surroundings than on global reference frames (as seen in the greater proportion of "same" responses by children to stories 3 and 4; story 7 did not reveal this pattern). Apparently, much of the development in this area has already occurred by age 10. Future research should involve younger children.

It is likely that subjects in this research gave responses based on the context suggested by the particular stories used. Probably the most significant challenge for future investigations is to pinpoint these elements of context more precisely, but in a way that captures their dynamic aspect more effectively. In many cases when place distinctions are made, additional elements of context are involved (communication goals and intentions, greater previous context to the communication, etc.) that clarify the intended place referents, even though they can vary rapidly and to a great extent when the physical situation is identical. Also, what differences are there in the linguistic and nonlinguistic partitioning of space? And what consequences does the partitioning have for behavior? Such research will lead us to a clearer understanding of this ubiquitous component of mental life and our relationship to the world.

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