

SPONTANEOUS PARTITIONING: PRE-SCHOOLERS AND DISCRETE ITEMS

ABSTRACT. This study addresses the question of whether a dealing strategy that is widely used by young children in clinical interviews occurs in less structured situations. Our findings are that it did not in the setting we examined, namely the performance of a routine counting task, by pre-schoolers with the opportunity of sharing sweets when the task was completed. We discuss reasons for the apparent discrepancies between the results for clinical interviews and less structured situations.

We use the following definition of dealing (taken from Davis and Pitkethly, 1990): *dealing* means a cyclic distribution of discrete objects, regarded as identical, with the same number distributed to each place on each round of the cycle, until there are no more cycles possible. This procedure is also known as distributive counting: see Miller (1984), for example.

In the simplest form of dealing a cycle occurs when one object is given to each place. One cycle in this simple form is an instance of one-to-one correspondence – one object for each place. This one-to-one correspondence is then repeated over and over until all objects are used or it is not possible to proceed further. In a slightly more complex form of dealing the number of objects placed at each spot is fixed within a cycle but may vary from cycle to cycle.

Dealing is a basic widespread activity that allows young children to apportion equal shares of discrete items. Miller (1984) observed that:

The vast majority of children at all ages employ a strategy of distributive counting in which pieces were distributed one at a time . . . often accompanied by statements such as 'one for you and one for you' . . . Distributive counting incorporates one-to-one correspondence in a very general way because it does not require children to determine the number present.

Hunting and Sharpley (1988) also commented on the high use of dealing as a sharing procedure in structured interview situations, and Clements and Lean (1988) in studying discrete fraction concepts in school children in Papua New Guinea report on the almost universal incidence of dealing as a strategy for sharing discrete items in a certain structured interview situation (in particular, in sharing betel nuts between imagined people).

In a structured interview situation, Hunting and Davis (1989), where pre-school children were asked, among other things, to individually share biscuits among dolls, dealing was the most common strategy. In fact in the

total population of 75 children in that study 85% demonstrated an ability to share 12 crackers between two dolls by dealing.

Davis and Pitkethly (1990) examined cognitive aspects of dealing by pre-schoolers, as seen by grade 2 children, and inferred that whilst in a structured interview situation a majority of children in fact deal without prompting, very few of the pre-school children or the older grade 2 children saw the action of dealing as sufficient to establish a fair share.

AIM

Our aim in this study was to probe the question of whether, in a situation less structured than that of a clinical interview, pre-school children would spontaneously deal out discrete food items, or count, or share them in any systematic way.

METHOD

46 pre-school children from a single kindergarten in a working-lower middle class Melbourne suburb were given a routine counting task. The children were placed into pre-arranged groups of 2 and 3, and they sat, one group at a time, at a small round table on which was placed a bucket and a pile of wooden animals for each child, and a single pile of 12 jelly beans.

The children were told that they should count the wooden animals into the buckets and that they could have the jelly beans when they had finished counting. There were two research personnel present in the room, both familiar to the children. One of these personnel gave the instructions to the children and then left them to perform the task without intervention, and the other, out of sight of the children, operated an overhead video camera.

The rationale for groups of 2 and 3 was that we wanted to obtain information on the ways in which these pre-school children would share a quantity of jelly beans into groups of 2 and 3. We used 12 jelly beans because 12 is exactly divisible by 2 and 3 and is large enough to cause the pre-schoolers to adopt a methodological procedure if they wanted to share fairly. The children were not told how many jelly beans were in a pile.

RESULTS

When the children in the study were asked to complete the foil task in groups of 2 and 3 and then have the jelly beans that were on the work table, we found a total absence of dealing in apportioning the jelly beans.

Most commonly the children grabbed at the jelly beans or picked them up one at a time, usually with each child appropriating their own share.

On a number of occasions some of the children in a group expressed dissatisfaction with their (low) share of the jelly beans. This usually resulted in a process of discussion, often followed by counting: the counting was usually, but not always, performed by those who expressed dissatisfaction. The children who had the larger share of jelly beans were not so inclined to consider the numerical evidence, nor to change their share on the basis of it.

We did not observe the children in any of the groups to place all the jelly beans on the table and deal them out: even when strong dissatisfaction had been expressed by one of the children in the group. In fact a total lack of dealing and very little overt counting in appropriating shares was apparent.

The action categories that we observed or expected to observe, and the number of children whose actions fitted into those (overlapping) categories is indicated in the Table I below.

TABLE I

Category	Number
Deal	0
Count first	5
Pick up systematically (for example one at a time, or two at a time)	12
Grab	22
Grab and count	13

DISCUSSION

There are some obvious questions to ask about the total absence of observed dealing. Did the children in the unstructured situation not see that dealing would help them? Did they not see that it was possible in their own interest to see that fair shares resulted? Was it the case that children's demonstrated ability to deal was somehow inaccessible to them, or was it that they saw no need to use this ability?

There are two obvious possible explanations for the children's behaviour:

- the first is that they did not see that dealing or counting would help them. This is despite the same children individually being able to deal or count adequately to apportion 12 discrete items fairly among 2 and 3 dolls.

- the second is that they did not see any need to establish a fair share. This may have been because they did not have it in mind to establish a fair share and simply took what they felt like.

On the face of it the first explanation seems a little far fetched: if the children are capable of dealing in one situation why would they not be capable of it in an almost identical situation? On the other hand we have difficulty with the second explanation because there were times when some of the children were unhappy with their share but neither they nor the other children in the group resorted to dealing to resolve the difficulty, and although some of them counted at this point the video records indicate that in general there was considerable confusion after the counting.

Here are two examples that illustrate the lack of dealing as a strategy to establish fair shares, when there was an expressed need to do so, and the general confusion that resulted from a perceived lack of a fair share:

Three children, Amanda, Jodie, and Paul, share the 12 jelly beans.

Paul (to Jodie): "Hey! That was my piece. I have one of those. I've only got three. How much have you got?" Jodie said three.

Paul (to Amanda): "How much have you got?"

Amanda emptied the bag into which she had placed her jelly beans onto the table. She gave one jelly bean to Paul and one to Jodie.

Paul: "Now have we all got five?"

Amanda: "We'll have to count them again."

At that point they left without counting. In fact they had not counted at any stage: Amanda and Paul initially grabbed a handful of jelly beans and Jodie joined in.

In the next excerpt, Clare and John shared the 12 jelly beans. They did so by grabbing without counting.

Clare: "Now we both got the same. Now measure it." They held the bags containing their jelly beans next to each other.

Clare: "Now we've both got the same."

John: "I only got ten. You tricked me."

Clare: "Did I get more than you?"

John: "Would you give me some of yours and I'll give you some of mine?"

Clare: "Alright. You have to promise. I'll give you one and you give me one."

John: "O.K."

None of the children in these groups initially counted or picked up jelly beans one at a time. As an example of two children one of whom picked up the jelly beans one at a time we have Stephen and Rory. Stephen picked up the jelly beans one at a time, counting as he went. He reached five when Rory grabbed.

Stephen: "Hey! Put them down!" He then picked up two more. The other boy, Rory, was unhappy with this and the boys asked one of the research personnel to intervene. The problem was resolved by finding more jelly beans.

In a previous clinical interview, Hunting and Davis (1989), all of these seven children shared 12 crackers to two dolls by dealing. In these interviews one child was interviewed at a time by a single interviewer. When an extra doll was introduced and the children were asked to give the three dolls a fair share of crackers, of this group only Amanda dealt again without prompting. The others tried to adjust the crackers previously shared between two dolls. Rory adjusted to give the dolls, 3, 4, and 5 crackers, whilst Clare could not get it right by her standards of adjusting, and when it was suggested she begin again she then dealt. The other five children adjusted the crackers so that an even share resulted.

Of the 46 children who participated in the spontaneous sharing exercise, 90% had previously demonstrated an ability to share 12 crackers between two dolls by dealing (Hunting and Davis, 1989).

Both in the relatively unstructured sharing situation where the children shared discrete objects among themselves, and in the structured clinical interview used in Hunting and Davis (1989), in which a sharing response was elicited by an interviewer for a child to share discrete items among dolls, many children had difficulty adjusting a pre-existing unfair share so that a fair share resulted.

So we are inclined to the view that even though the children may not initially have been concerned about fair shares, when they were so concerned they did not see that dealing would help them. This fits in with the conclusion of Davis and Pitkethly (1990) that in a structured interview situation almost all pre-school children resort to dealing to obtain a fair share but almost without exception they, or even children several years older than them, seem to be unaware that dealing is in itself adequate to establish fair shares. Mulligan (1988) also mentions that of 34 pre-schoolers through grade 2 children she studied in non-interview problem solving situations, not one spontaneously used dealing where it would have resolved a sharing problem. It is as Steffe (1988) says: "Children's operations

seem to be primarily outside their awareness, and, without the use of symbols, they have little chance of becoming aware of them nor can they elaborate those operations beyond their primitive forms."

This raises a very important pedagogical issue. Most children at age 4 or 5, and probably even earlier, have at hand an action scheme – a tool – that will allow them to resolve many apportioning problems. We now know that although the children have and use this action scheme of dealing in certain structured situations, they are generally unaware that it works. This lack of awareness is not simply a failure of expression by very young children, but can be seen and analysed in their subsequent actions in checking for fair shares. As pre-school children progress into primary school the dealing procedure for apportioning shares seems to be gradually overtaken by counting.

This seems to be a real loss, because dealing can be used by a pre-school or infant teacher as an almost universal action scheme for introducing concrete experiences that deal with fractions and ratios of discrete items. Dealing allows children to apportion discrete items evenly, and they can all do it. It can be used therefore in experimental situations in which children gather evidence, over an extended period, about how many discrete items each person gets when a certain number is apportioned fairly. Our results on spontaneous sharing indicate that if this is not attended to by a teacher at this point then the children probably will not discover it for themselves.

Clements and Del Campo (1988), among others, have raised the question of the naturality of fraction knowledge. In the experiments we have reported here we are dealing with pre-fraction knowledge and we believe that if pre-school and infant children are not given appropriate experiences that allow them to build on and reorganize their own action schemes then they will not of and by themselves, in their everyday experiences, develop fraction and ratio knowledge.

We think it is important to discover the *origins*, as distinct from the use, or lack of it, of the dealing scheme, because there is some evidence that it is a very common action scheme across different cultures, and because it could potentially be used at an early age to help children build knowledge of fractions, ratios, and proportions. Some questions that come to mind are the following. Is it rooted in a child's early experiences with parents or siblings? Does it arise spontaneously without training? Are there sharing activities in early childhood that strengthen a child's capacity to share by dealing, or is this capacity largely unaffected by the presence or absence of such activities? Do first children have the same capacity to deal, at say 4 years of age, as later children in a family? Is the manifest capacity

to deal culturally bound or is it largely independent of culture? The cognitive question that we need to ask is: what is it about young children's brains that allows them to construct a response such as dealing to a problematic situation?

These questions are important because we see dealing as a very common sharing strategy in children's interaction with adults in structured interviews but we do not see dealing as a strategy to solve a problem between children, even when, as in Mulligan's (1988) study, dealing would have resolved a perceived problem. It may be that interviews focus a child's mind more directly on a problem, but again research suggests that, even with this focus, dealing is not used without an adult presence. On the other hand it is widely used in the presence of adults. What is it about the child/adult interaction that seems to produce dealing as an appropriate response to a sharing problem? This may, of course, be a function of the structure of the interviews and not a consequence of the fact that it is adults who do the interviewing.

A preliminary account of this research was presented at the 1988 Mathematics Education Research Group in Australasia's conference (Davis and Hunting, 1988).

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