CAN PROBABILITY COMBINATIONS/ ESTIMATIONS BE ASSESSED IN PRESCHOOLERS WITH THE USE OF COMPUTERS (POWERPOINT)?

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The aim of this study is to assess and investigate how many combinations can be manipulated by preschoolers in a probabilistic task. The task was computer- based and included 3 trials with alterations among the colour- combinations and proportions of the sample space. With the use of intuitive thinking or more concrete reasoning children at the age of 5-6, showed that they posses the notion of most/least likely when there are 2 and 3 combinations (not 4).

INTRODUCTION

Children as early as 5 years-old possess and can develop some basic statistical and probabilistic concepts. Either by using intuitive reasoning (Schlottmann, 2001; Andreson, 1996; Acredolo et al, 1989) or by using more concrete cognitive mechanisms such as the ability of inference making and similarity selecting (Deak et al, 2002; Kushnir& Gopnik 2005), preschoolers understand the risk alternatives and the likelihood of outcomes. Research has shown that children can make use of the basic probability notions: possible, impossible, sample space (Schlottmann, 2001; Pange & Talbot 2003; Way, 2003, Kafoussi, 2004).

In contrast to the notion of centration- that children are able to concentrate on a single dimension confined by the similarity of appearance, without the ability of reasoning multiple variables and relating parts to the whole (Piaget & Inhelder, 1958)-, it has been found that children can make inferences and handle more than 2 combinations, especially when the stimulus is presented in a spatially grouped order. Children can recognize correlations, make inferences and make use of the frequency of co-occurrence (Kushnir& Gopnik, 2005). Based on visual information, children show a minimal understanding of randomness and can identify the most/least likely outcomes (Way, 2003).

Children express and develop probabilistic ideas, depending on the design of the given activity (Papaparistodemou, 2004; Pratt, 2000). The structure of the sample space and the number of combinations are part components of a probability task. Another aspect of great importance concerning the design of a probability task is the use of New Technologies. The advantages of New Technologies in the preschool classroom have been underlined lately (Pange, 2002). Computers are educational tools that allow the learning of statistics to be evaluated and enhanced by providing new opportunities in the teaching/ learning process.

In the current study, a computer- based task was used in order to assess and investigate to what point preschoolers can manipulate and make use of multiple probability combinations. Based on the idea that the primary purpose of the assessment of young children is to help educators determine appropriate classroom activities with appropriate learning goals (http://www.state.nj.us/njded/ece/index.html), if we can identify whether children can understand up to 4 probability combinations, then we can enrich the teaching- learning of this area.

In more precise, children at the age of 5 to 6 were presented with a game supported by PowerPoint and were encouraged to get personally involved in order to predict, estimate, and construct (basic concepts of the constructivist approach; DeVries et al, 1990; Osborne and Freyberg; 1985). Children were expected to discriminate and justify each time their predictions based on the likelihood of the sample space; they were expected to present the most/least likely notion within a sample space of 5 items with gradually 2 to 4 combinations.

METHODOLOGY

There were 30 children from a public kindergarten in Athens, aged 5 to 6 who participated. The experiment was conducted (during 2007) as a game on the computer and there were 2 conditions, each divided into 3 trials. Each trial presented a bee that was about to select 1 out of 5 flowers at a time, in order to rest.

Children, individually, were seated in front of the screen and observed the 'story' of the bee and the flowers. A bee after flying all day long felt tired and decided to approach a field full of colourful flowers in order to rest and came near to only 5 each time flowers. When the narration (made by the researcher while the animations of PowerPoint ran) reached the moment that the bee had to select one colour- flower among five, the children were asked to make a prediction with justification. As soon as they gave their response, the bee would fly to the programmed colour-flower.

In every trial the sample space was consisted of 5 flowers, with different each time colour- combinations. In precise:

- In *trial 1* there were 4 red and 1 white flower (i.e. 2 colour- combinations, where red was the most dominant)
- In *trial 2* there were 3 red, 1 white and 1 pink flower (i.e. 3 colour- combinations, where red was more dominant)
- In *trial 3* there were 2 red, 1 white, 1 pink and 1 yellow flower (i.e. 4 colour-combinations, where red was slightly more dominant).
- In Condition 1 (Figure 1), in every trial, the bee was programmed to select a red flower (the most likely). In Condition 2 (Figure 2), the bee would stop at any other colour apart from the red (trial 1: white, trial 2: pink, trial 3: yellow). In both conditions the sample space and the arrangement of the colour- combinations was the same, as well as the story. Participants would first predict and explain their estimation and then the bee would reach a flower.

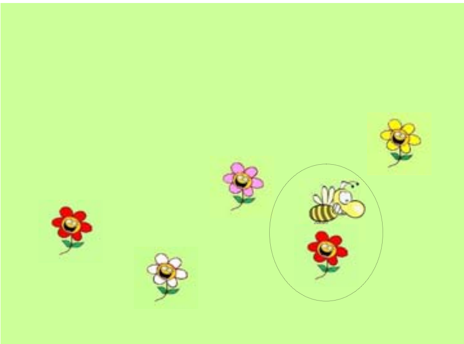

Figure 1: Example of trial 3, Condition 1 (4 colour-combinations).

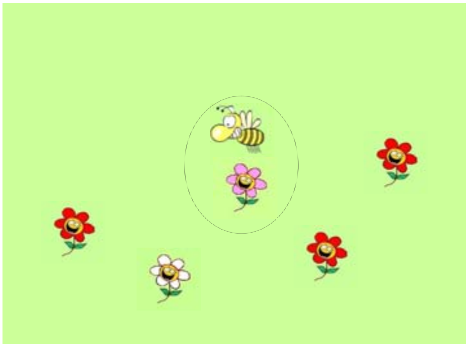

Figure 2: Example of trial 2, Condition 2 (3 colour- combinations)

In every trial the discussions and estimations were tape-recorded and used for further analysis. The responses were explored in order to find out to what point preschoolers possess the most/least notion (2, 3 or 4 combinations within the sample space) and how they justify their predictions.

RESULTS

Children (*N*=30) were quite enthusiastic in taking part in the 'computer' game. They were totally engaged in the activity and seemed to be happy with the task; they even asked for more.
In every response children presented justifications based on either intuition and personal preferences or on more scientific reasoning, co-occurrence or most/least likely. In both cases, their probability estimations provided information concerning their mental understanding of probabilities.

In the *first trial* of both conditions, 25 children predicted that the bee would select a red flower as there were 4 red and 1 white one. It was evident that they could express the most/least likely notion:

Nefeli: She will go to a red flower as there are more red than white flowers…
Nikos: White is only one, the bee won't go there…

In the *second trial* (when there were 3 colour-combinations) 19 children guessed that the red flower would be the most likely to be chosen by the bee. Children could identify and estimate that as the red flowers possessed the greater amount of the sample space, the red would be the most possible colour to be picked by the bee:

Panos: Red because they are more...

In the *third trial* (4 colour-combinations), only 8 children used red as the colour of their inference- making. With the addition of more information (more colour- combinations), children seemed not to be able to predict and make judgments by using probabilistic thinking. They would rather answer randomly:

Andreas: I think the bee will choose yellow, as she is yellow…

In addition, in *Condition 1* when the bee would always land on a red flower, 33 out of the 45 responses would be 'red'. There was strong evidence of understanding co-occurrence:

Nikos: Red, because this bee chose red yesterday too.
Makis: As before, red…
Lena: She (the bee) prefers the red flowers…

In C*ondition 2*, this was not the case. Most responses were based on chance and personal justifications. Here, the bee was programmed not to choose the most likely colour, but a random flower each time:

Agapi: Pink, pink is my favorite answer…
Ioanna: She will choose yellow as yellow is the color that gives more vitamins.
Pavlos: White because bees like white flowers.

DISCUSSION

Children could understand that the colour-combinations of the sample space changed in each trial. They were aware of the colour differences within the 5 each time flowers of the sample space. This supports that they based their reasoning on visual impressions and comparisons, according to the non- probabilistic thinking (Way, 2003). Children showed a strong reliance on what could be seen and quite often justified their choices in terms of the comparative amount of the coloured flowers.

They were able to identify the most/ least probable colour, by taking into account the combinations of the colours and their dominance within the sample space. This was strongly evident when there were only 2 and 3 colour- combinations. With the entrance of the 4th colour, children would justify and reason their choices by using limited probability judgments (Jones et al, 1997) and responses based on chance. In general, children showed an ability to focus on more than one variable counter to the Piagetian notion of centration.

The justifications preschoolers gave, in other cases (trials 1 and 2; 2 and 3 combinations respectively) revealed a more concrete reasoning and in other cases (trial 3; 4 combinations) showed intuitive thinking. Overall, the responses, provided information on the children's developmental understanding of probabilities, concerning the number of combinations within a stable sample space. Precisely, children could operate 'scientifically' with 2 and 3 combinations, but with 4 they had difficulties. This information helps us assess their understanding and therefore organize classroom activities correspondent to these capacities. With the use of New Technologies, information can be gathered and preschoolers' capacities on making probability estimations can be identified.

Methodologically, the current experiment made use of a computer- presented task. As the design of an activity is quite important in how children express probabilistic ideas (Papaparistodemou, 2004; Pratt, 2000), the computer seemed to have positive effects. From the very first moment the children were very impressed by the computer and their interest and stimulation was very evident. Either way, the advantages of the New Technologies as an educative tool and not a replacement of the teacher have been stressed a lot lately (Pange, 2002; Hosie & Mazzarol, 1999).

Further research could explore more profoundly how the different combinations of a sample space (up to four) are processed within different task designs; i.e. with other stimuli (animals or icons), other combinations (not colour as in the present study but numbers or items), other meaningful context (always under the perspective of a childish story). We further explore how the 4 combinations can be explored within different sample spaces. In addition, how can assessment be integrated in teaching: how can the evidence that children are capable of working with 2 and 3 probabilistic combinations be incorporated in instructional planning with developmentally appropriate learning goals?

To sum up, computer- based tasks comprise a way of assessing children's understanding, which in turn can provide guidance for teaching. Children can work and use probabilistic thinking with 2 and 3 combinations in problem solving tasks, the next step is to plan appropriate classroom activities.

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