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What is it about Science Experiments that Fascinates Children? The Role of Novelty and Intensity

Angelika Pahl[1], Reinhard Tschiesner[2]

Abstract

Teachers and researchers note an atmosphere of interest and joy when conducting hands-on science activities at primary schools. However, the question is, what is the reason for this evident fascination in children? A first answer that might generally be given by people who find themselves confronted with this question is that children simply are curious about the (natural) world around them. In this article we are going to give a more differentiated explanation for why children are so fascinated and why certain science experiments might be more fascinating for some children than others. Obviously, the stimulus in form of the experiment itself is one elicitor of fascination, but what are the specific aspects and characteristics of an experiment that particularly appeal to children, with their individual needs?

We know from perceptual research that sensory stimuli lead to psychophysical activation. Wundt already explained that people differ in their preference of stimuli. He suggested that this preference becomes obvious by the fact that different people prefer different degrees of intensity of stimuli. Later Arnett added "novelty" in his concept of stimuli preference. It can therefore be stated that some people prefer novel and intense stimuli and other people prefer well-known stimuli and stimuli with a low intensity level.

In science lessons, especially at primary school, many teachers use everyday materials for carrying out science experiments with children. In most cases, objects from the living environment are well-known by the children. The pertinent question here is why science experiments with everyday materials elicit fascination in children even though the object itself is well-known. In order to adequately meet this question, we will present theories dealing with arousal and arousability in connection with hands-on science activities in primary schools. We thus hope to gain a better understanding for the didactic shaping of science experiment settings by teachers for children of primary school age.

1. Introduction

Children like to experiment. Lück [1] for instance found that most boys and girls voluntarily participated weekly over a long period in hands-on science activities in kindergarten, even when other activities were offered. In another research study, preschool children were asked where they would like to go on an excursion. Most children preferred to go to a laboratory for carrying out science experiments than to visit a music school, a library, or an art museum [2].

First and second graders visiting a science lab spent 80% of their time doing hands-on science activities, even though they had the opportunity to take a food break, to watch television, or to paint. They were so enthusiastic that they insisted on going on with further science experiments [3]. Also during the lessons in primary school, pupils show a particularly high interest and joy when conducting science experiments and are furthermore willing to repeat science experiments at home voluntarily [4]. Accordingly, 80% of fourth-graders stated in a national survey (IGLU-E-study) that they like to explore phenomena with science experiments [5].

Simple science experiments with everyday materials offer children numerous opportunities to observe aesthetic and impressive natural phenomena. Researchers have noted that children often become contemplative and are completely focused on the scene and immersed in the experimental process, ignoring distractions and losing track of time. They pursue what happens with attention and curiosity and are surprised when something unexpected appears. Frequently, the success of the experiment evokes happiness [1].

In sum, children show their interest in hands-on science activities through persistence, frequency and intensity of handling, and attention in experimental situations [6].

[1] University College of Teacher Education Bern, Switzerland
[2] University College of Teacher Education Styria, Austria

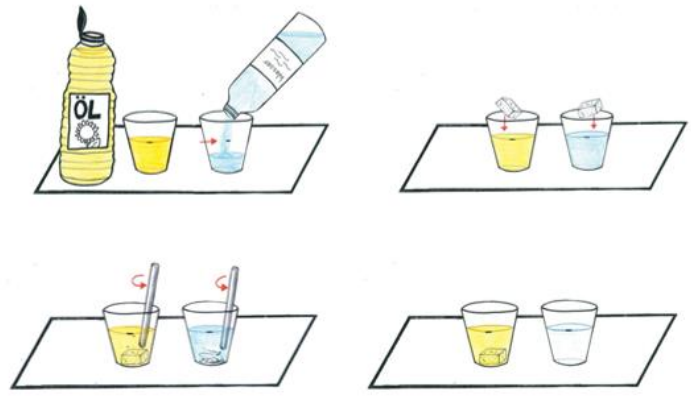
Sugar Experiment

Dissolving sugar in different liquids (water and cooking oil)

► *Needed materials:*

2 glasses, water, cooking oil, 2 sugar cubes, 2 stirrer or 2 spoons

► *Experimental procedure:*



► *What's happening?*

Only water dissolves sugar. The sugar cube disappears in water, but not in cooking oil.

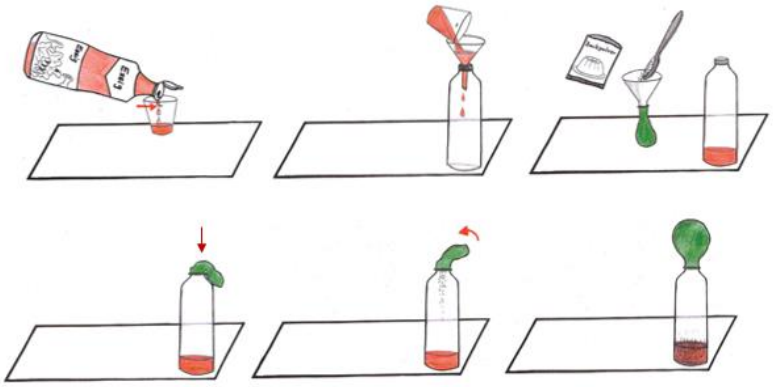
Balloon Experiment

Blowing up a balloon (using baking soda and vinegar)

► *Needed materials:*

1 empty plastic bottle, vinegar, baking soda, 1 glass, 1 teaspoon, 1 balloon, 2 funnels

► *Experimental procedure:*



► *What's happening?*

When baking soda and vinegar come in contact, the mixture begins to fizz and bubbles become visible. The Gas (CO_2) produced from the two ingredients inflates the balloon.

Fig.1.: Two examples of science experiments using everyday materials with different levels of novel and intense stimuli

Teachers are familiar with both shy children and those who are constantly looking for novel or intense stimuli. What is it about science experiments with objects of everyday use that fascinates children with such contrasting personalities and needs? Obviously, science experiments vary and present different novel and intense elements for pupils.
A science experiment such as dissolving sugar in water is better known to children from everyday life than, for example, an experiment in which a balloon is chemically inflated using baking powder and vinegar. While the Sugar Experiment allows children more moments of contemplative observation and a place to linger on the aesthetic natural phenomena, the Balloon Experiment is associated with more complex action steps and excitement (see fig. 1).

2. Theoretical Background

In this part of the article we are going to give an explanation of the concepts Surprise/Interest, Curiosity as well as Sensation Seeking and demonstrate their importance for understanding children's behaviour during hands-on science activities.

2.1 Surprise/Interest

The concept of Surprise/Interest is an issue in research of emotions and basic emotions [7, 8]. The term basic emotions describes emotions which could be found in any person (and even in higher mammals) and any cultural context. They manifest in physical activity of face muscles [9]. Surprise/interest, for instance, are signalized by an attentive look, dilated pupils and (sometimes) an open mouth. To be strictly accurate, Interest contrasted to Surprise is more of a kind of theoretical construct, which is described by researchers through the expression of Surprise. Several authors do not distinguish between Interest and Surprise, simply using the term Interest [i.e. 7]. Just like other basic emotions, Surprise signalizes an emotional state and a readiness to act. In the case of Interest, people feel a kind of attentiveness, which manifests in thoughts like "what I perceive at the moment is new or unexpected". At the same time, the person is ready to do something, which could be described by thoughts like "I want to find out more about it" and the demand for more information about it [7]. Krapp [10] create a further differentiation within the concept of Interest. He defines situational Interest as a state elicited by a concrete situation, for instance an exciting lesson. Interest in this case does not necessarily last. It only turns into dispositional Interest if the elicitor of Interest is long-lasting, important for a person, and associated with positive emotions.

2.2 Curiosity

Curiosity as a concept is phenomenologically similar to Interest. Voss and Keller [11] underline that Curiosity has to be distinguished from exploration. Exploration is based on (observable) behaviour, whereas Curiosity is characterised by an experience. Deci and Ryan [12] suggest that Curiosity can be seen as a prototypical example of intrinsic motivation. Berlyne [13] defines Curiosity as a reaction to novel stimuli, which involves feelings of Interest or uncertainty. Both motivate to explore the novel stimuli in order to acquire new information. Berlyne [13] distinguishes between epistemic and perceptual Curiosity. The difference between them lies in the stimulus itself. Epistemic Curiosity is elicited by complex ideas or ambiguities. They motivate the person to ask questions and test hypotheses with the aim to gain knowledge. Perceptual Curiosity, however, is evoked by complex or ambiguous patterns of sensory stimulation and leads the person to close observation and acquisition of new information.

3.3 Sensation Seeking

Zuckerman [14] defines Sensation Seeking as a trait which is marked by the seeking of varied, novel, complex and intensive sensations and experiences. In light of this, people with this trait take physical, financial, legal and social risks. Unlike Zuckerman, Arnett [15] considers the seeking of novel and intense stimuli to be essential for Sensation Seeking and doesn't make a reference to risky behaviour. The Sensation Seeking trait is theoretically based upon three founding pillars: the deprivation studies, the theory of the optimal level of stimulation as well as arousal, and the theories dealing with drives and reduction of tensions. In deprivation studies, Zuckermann [14] investigated different conditions of Isolation (sensory or social) and found out that people differ in their craving of stimuli. The theory of an optimal level of stimulation can be tracked back to Wundt. In the 1950ies, the neurological basis for the optimal level of arousal was found and the role of the reticular activating system evidenced. The

third pillar, Freud's drive or instinct theory, suggests that behaviour is determined by drives and their vicissitudes. Balint [17] observes two types of persons, which are similar to the high and low sensations seekers. He establishes the philobatic and the ocnophilic person. Whereas the philobatic one is always looking for thrills or novel or intense stimuli, the ocnophilic doesn't neglect safety, appears shy and avoids novel or intense stimuli. To be accurate, we have to keep in mind that Balints concept of philobatism and ocnophilia differs in several points to the Sensation Seeking concept.

3. Conclusions

The definitions of the three concepts seem clear but the distinction of them in the field is slightly difficult. Compared with Curiosity, the concept of Sensation Seeking is more comprehensive. Sensation Seeking includes Curiosity and explains both concepts theoretically. Emotions like Interest/Surprise are linked to motivational systems like Curiosity or Sensation Seeking. The psychoanalyst Benecke [18] explained that affects are the tools of motivational systems, which in the conceptual hierarchy rank above emotions. Researchers mention that Interest can't be observed because it is a hypothetical construct. However, we are able to observe expressions of Surprise and/or Joy when doing hands-on experiments with children.

To return to our earlier question, why then do science experiments with everyday materials elicit fascination in all children regardless of personality? Children who prefer not to leave safe harbours are happy about the objects used in the experiments, because they are well known from their everyday life and everyday situations. Their familiarity with the objects satisfies the need for safety. Therefore, everyday materials become a good didactic starting point for children who avoid intense and novel stimuli. Furthermore, science experiments with low intensive effects appeal to them. Children assigned to the second type prefer the intensive or novel elements of the experiments. Objects with which they are daily in close contact did not arouse their interest. Rather, these children are most likely attracted by the effects of experiments, which in some cases are associated with an abrupt change of sensory stimulation. The change may consist of the appearance of novel (bubbles) or intense (explosion) stimuli, which are satisfying the need for novel and intense experiences.

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