

Analogical Transfer Despite Misleading Information in Toddlerhood and Beyond

Analogical Transfer Despite Misleading Information

An Eye Tracking Study

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Analogical transfer requires prioritizing relevant information over irrelevant, distracting or misleading information. Previous research showed that even 6-month-olds can prioritize relevant information over irrelevant, distracting information (Brito & Barr, 2014). However, whether and when children can prioritize truly over seemingly relevant information remains understudied. The absence of misleading irrelevant information is a luxury that neither children nor adults can afford outside of experimental setups. As overcoming such information is a hallmark of everyday problem-solving and is potentially key for learning and academic achievement, it will be investigated in the proposed project. Children between 2.5 and 5.5 will participate in large-scale eye tracking studies, in which they will need to overcome a similar-looking but irrelevant experience in favour of another, different-looking but relevant experience. Flexible problem solving is an important skill in academic performance, life-time achievement, and individual participation in the democratic society but developing relevant trainings demands, first, a better understanding of how flexible problem solving develops, and precisely this demand is addressed in the project.

Additional Keywords and Phrases: Analogical transfer, Eye tracking, Toddlers, Preschool, Working Memory, Executive Functions

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1 BACKGROUND

Analogical transfer, the ability to prioritize relevant information over irrelevant information, plays a prominent role in cognitive development. This ability is a hallmark of human problem solving and innovativeness, as it allows for generalizing knowledge acquired in familiar, past solutions to any unfamiliar, present situation. Analogical transfer begins to develop early, in the first year of life, and markedly improves throughout toddlerhood and the preschool years.

Generalizing knowledge across situations draws on detecting common functional features and disregarding other, functionally irrelevant information. Children learn to discern between functional and non-functional information in the first year of life, both through own actions and observing others (Leslie, 1984; Luo et al., 2009).

By the end of the first year, children can detect functional similarities between unfamiliar objects, as long as the common function was presented beforehand (Träuble & Pauen, 2007), and even start to transfer knowledge about object function across situations (Madole et al., 1993). Proficiency at such transfers comes, however, later, around 30 months, as corroborated by several studies involving deferred imitation (Herbert & Hayne, 2000), object search (DeLoache et al., 2004) and physical tool use transfer (Bobrowicz, Lindström et al., 2020). Only around 30 months children would spontaneously, unprompted by external verbal aids, transfer knowledge across two perceptually dissimilar but functionally similar situations.

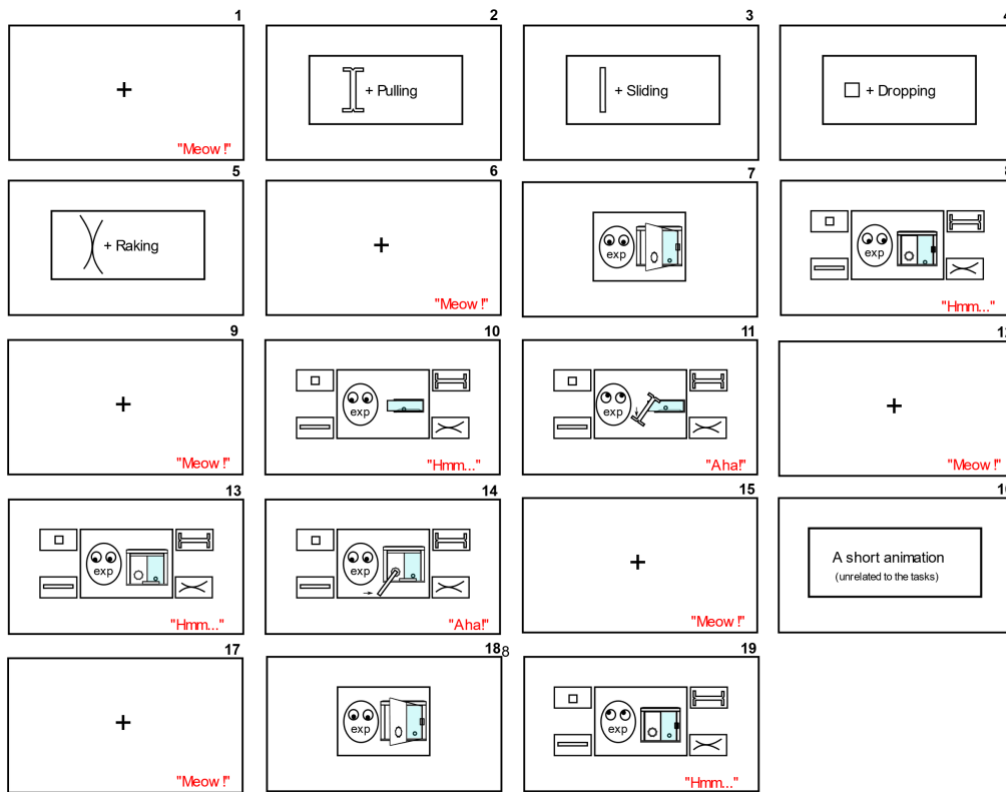
Although all generalization tasks require prioritizing relevant information over irrelevant information, the irrelevant information may play two different roles in flexible problem solving, namely, a distracting or a misleading one. Distracting information was consistently irrelevant under similar past circumstances and remains irrelevant in the present. Misleading information was relevant under similar past circumstances but is now irrelevant and therefore competes with the truly relevant information. Previous research suggests that the ability to disregard misleading information is more difficult, draws differently on executive functions and most likely develops later than the ability to disregard distracting information (Blakey et al., 2016). Children can spontaneously disregard distracting information around 30 months, when inhibition and working memory are sufficiently developed to support this task (Blakey et al., 2016). Although it is unclear when children can spontaneously disregard misleading information, task switching that is critical to this task develops between 36 and 42 months, that is, 3 and 3.5 years (Blakey et al., 2016). Previous findings from several areas of developmental psychology suggest that switching implicated in the ability to disregard misleading information develops even later, between 4 and 8. Research on planning showed that goal representation critical to such switching is sufficiently developed around 4 (Dietz et al., 2019). False-belief studies corroborated this developmental timing, suggesting that around 4 children start to switch between own and others' current beliefs (Baron-Cohen et al., 1985), as well as their own past and present beliefs (Astington & Gopnik, 1988; Flavell et al., 1983). On the other hand, EF studies suggested that switching that involves inhibiting misleading information may be sufficiently developed later, at 5-6 years of age (Zelazo, 2006). Finally, analogical reasoning studies showed that only 8- but not 5-year-olds fully understand tasks that require prioritizing truly relevant information over seemingly relevant information (Thibaut et al., 2010; Richland et al., 2006). Overall, previous research suggests that the ability to disregard misleading information may be sufficiently developed at 4 to 8 years, but this ability has not been directly investigated before.

2 METHOD

The ability to disregard irrelevant, distracting or misleading, information in favour of relevant information in 2.5- to 5.5-year-olds will be investigated in the current project. As looking-time measures have repeatedly and successfully been used to study cognitive development (e.g., Eckstein et al., 2017) and allow for reducing verbal and motor demands of experimental setups, such measures will be used in the project. To determine whether participants are actively attending to objects, heart rate and pupil dilation will also be measured. Changes in attention are directly observable in heart rate changes (Pempek et al., 2010), and in pupil dilation changes (Eckstein et al., 2017), in both children and adults. As the anticipatory looking paradigm was successfully used in participants as young as 15-months (Onishi & Baillargeon, 2005), this paradigm will be used in the current project. In this paradigm, a participant, regardless of her age, anticipates an observed agent to act in a certain way and in a certain location and looks towards this location soon before the agent does so. The methods used in the project are based on previously established methods and techniques that proved to be safe for participants of involve eye tracking

and heart-rate monitoring techniques, as well as non-verbal tests of executive functions and working memory. Verbal demands of the tasks will be minimized across the tests. Cross-sectional designs will be used at the beginning of the project and accompanied by longitudinal designs later in the project.

To test whether children can transfer functional knowledge despite misleading information, each participant will be assigned to one of three experimental conditions: (1) Control, in which participants will acquire only irrelevant knowledge, (2) Transfer Despite Distracting Information, in which participants will acquire only truly relevant knowledge and some irrelevant knowledge, (3) Transfer Despite Misleading Information, in which participants will acquire both truly relevant knowledge and seemingly relevant but in fact irrelevant knowledge



(Figure 1).

Figure 1: A schematic overview of the testing sequence in the Transfer Despite Misleading Information condition. (1,6,9,12,15,17)

Attention-grabbing screens. (2-5) Presentations of motor actions associated with each tool. (7, 18) Presentations of the target task mechanics, as the door is closing without experimenter's involvement. (8,19) Presentations of the target task and the tools, without solving the task. (10-11) A presentation of the first problem and its solution. The experimenter first says "Hmm.", looking toward each of the four tools in a pseudorandomised order. After a short pause, she says "Aha!", looks towards the correct tool and opens the box. (13-14) A presentation of the second problem and its solution. The procedure with "Hmm...", "Aha!" and tool choice is repeated. Note that "exp" stands for "the experimenter."

In each condition, participants will watch a certain target tool-use problem twice, at the beginning and at the end of the testing. In between, they will always watch how two other problems are solved by the experimenter. Namely, participants will watch either (1) two functionally irrelevant problems that look different than the target

problem, (2) two problems that look different than the target, one of which is functionally relevant, and the other is irrelevant, and (3) first, a functionally relevant problem that looks different than the target, and second, a problem that looks the same as the target, but in fact requires a different solution.

3 SIGNIFICANCE

Although the ability to disregard irrelevant, distracting information in favour of relevant information was investigated in young children, it is unclear when the ability to disregard irrelevant, misleading information develops. Building on previous comparative and developmental psychological research, this project uses an established paradigm in an innovative design that allows testing flexible problem solving in very young children. In the era of considerable individual engagement in politics and social media in the information society, the ability to disregard misleading information is perhaps more important than ever before. Furthermore, focusing on individual problem-solving flexibility, promoted in the current project, has implications for changes in assessment of child's achievement and progress in the schooling system. Since in early education accumulating information is prioritized over operating on such information, there is no continuity between problem solving at the preschool level, and critical thinking in adolescence. There is also little space for assessment of individual, not standardized development. Shifting the current emphasis toward individual flexibility will, at least to some extent, hinder grouping children into performing below, on and above average and promote focusing on individual course of development instead, both in typically and atypically developing children (Vygotsky, 1978).

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