



## PAPER

## 36-month-olds conceal visual and auditory information from others

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### Abstract

*By three years of age, children are skilled at assessing under which circumstances others can see things. However, nothing is known about whether they can use this knowledge to guide their own deceptive behaviour. Here we investigated 3-year-olds' ability to strategically inhibit or conceal forbidden actions that a nearby adult experimenter could see or hear. In the first experiment, children were more likely to disobey the adult when she did not have visual access to their activities than they were when she was looking at them. In the second experiment, in which the adult could never see the child, children refrained from making noise when engaging in a prohibited action that the adult might hear. These results suggest that by three years of age children use their knowledge of others' perceptual states to decide whether it is safe to commit a transgression and, moreover, actively conceal perceptual cues that could reveal to others their ongoing transgression.*

### Introduction

Converging evidence indicates that by 36 months of age children have a sophisticated understanding of others' visual experience, and specifically know that others can see things that they cannot, and vice versa. Before their second birthday children do not just look in the general direction of another's gaze, but actually follow the other's gaze direction to the target location even in the presence of distractors (Butterworth & Cochran, 1980; Butterworth & Jarret, 1991); they also know that another person's eyes must be open to see the target, and that there must be an unblocked line of sight between the eyes and the target in order for that person to see something (Brooks & Meltzoff, 2002; Caron, Butler & Brooks, 2002; Dunphy-Lelii & Wellman, 2004; Lempers, Flavell & Flavell, 1977).

From 24 months onwards, children pass Level 1 visual perspective-taking tasks, designed to test whether they understand that the content of what they see may differ from that of what others can see. This has been shown by Moll and Tomasello (2005) in a study in which children have to infer which of two objects the adult experimenter was searching for. One of the two objects is in the open, whereas the second one is visible for the child but is occluded from the adult's perspective. Children at this age, but not younger, can use their knowledge of what the adult can and cannot see to determine which object he must be looking for. Consequently, they can make the correct choice and retrieve the object that is occluded

from the adult's perspective. By 30 months of age, they can verbally report what they and others see in the classic Level 1 task (Masangkay *et al.*, 1974). In this task, the experimenter shows a card to the child with two different objects depicted on each side. While looking at one side of the card, the child must say what another person sitting in front of him and looking at the other side of the card must be seeing. Furthermore, 30–36-month-olds know how to use this knowledge to prevent others from seeing things when they are instructed to do so by an adult experimenter. That is, if they are given explicit instructions to hide an object so that another person cannot see it, they can hide the object by moving it behind an occluder (Flavell, Shipstead & Croft, 1978; Lempers *et al.*, 1977). By the age of 3, children can in addition hide objects from others by placing an occluder in front of the object (McGuigan & Doherty, 2002). Thus, 3-year-olds can accurately infer what others can and cannot see, and, when instructed by an adult experimenter, they can use this knowledge to hide objects from others.

However, very little is currently known about the ontogeny of young children's knowledge about other perceptual modalities, such as the auditory modality. There is some evidence that 3-year-olds understand how factors such as distance and occlusion can affect different sensory modalities (Yaniv & Schatz, 1988). For example, children understand that someone who cannot see something (because the line of sight between the person and the target has been occluded) is not necessarily

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unable to hear it. In a study conducted by Yaniv and Schatz (1988), 3-year-olds were asked whether a puppet was able to see, hear, smell and touch various stimuli (such as a squeaking pig and flowers) when the puppet and the stimulus source were in two different rooms separated by a single wall. Three-year-olds correctly answered that, although the perceiver (the puppet) cannot see, smell and touch the pig or the flowers, he can *hear* the (squeaking) pig. Apart from this there are no other studies investigating young children's understanding of auditory perception in others.

Although the research on visual perspective-taking skills has shown that children possess a nuanced understanding of what and when others can see things by three years of age, no studies have investigated whether they can spontaneously (i.e. without explicit instructions to hide something) use this knowledge to guide their own deceptive behaviours. Concealing objects or oneself from others requires that the agent adjusts its behaviour to what the other person can see or hear, or, in some more difficult cases, may require that the agent anticipates what the other will see or hear. Thus, it requires perceptual role-taking and the intent to manipulate the other's behaviour (and possibly knowledge state) by withholding visual and/or auditory information. Visually and acoustically hiding an activity from others, or concealment, may in fact be the simplest form of deception (Whiten & Byrne, 1988), as it does not necessarily require an understanding of false beliefs. Whereas active misleading involves both a desire to have someone do something, and a plan to instill a belief in them that will make them do it, concealing only involves the desire that someone not see or know something (normally so that they will not do anything).

The aim of the present study was to investigate 3-year-olds' ability to engage in visual and auditory concealment of an ongoing transgression. Three-year-olds have been observed to practice some forms of deception, such as verbally denying a past transgression (Dunn, 1988; Lewis, Stanger & Sullivan, 1989; Polak & Harris, 1999; Talwar & Lee, 2002, 2008; see also Vasek, 1986; Newton, Reddy & Bull, 2000, for natural observations of 2.5- to 3-year-olds denying past transgressions). However, no studies have investigated whether they can withhold perceptual information from others during a transgression with the intent of manipulating the other's behaviour and possibly their informational state.

Some evidence suggests that children from 2.5 years of age might have a rudimentary understanding of the relationship between perceptual access and informational state. O'Neill (1996) examined 2-year-olds' responses towards an ignorant versus a knowledgeable adult to determine what they understand about the 'seeing-leads-to-knowing' relation. The primary measure was whether children would point to indicate the location of an inaccessible hidden toy less for an adult who had seen the

toy hidden. Children tailored their communicative gestures to the past perceptual experience (and knowledge state) of the adult. Dunham, Dunham and O'Keefe (2000) replicated and extended these results by showing a difference between younger and older two-year olds. In their study they added a sham hiding condition, in which the adult closed their eyes briefly but then actually watched the hiding process. This condition revealed an important change occurring between 2 and 3 years of age. Young 2-year-olds behaved in this condition as if the adult had *not* seen anything, showing that they were merely reacting to the social context of the hiding game; older 2-year olds, in contrast, accurately adjusted their communicative gestures to the visual experience of the adult. Neither O'Neill (1996) nor Dunham *et al.* (2000) interpreted their results as evidence for a true understanding of the causal relation between sensory information and knowledge. Instead, O'Neill suggested the 'disengagement and updating hypothesis', which implies that children were sensitive to the adults' past state of 'engagement' in the game and wanted to update them about events that happened while the adult was disengaged. Dunham *et al.* (2000) added that what the older 2-year-olds were doing was using more specific cues to assess 'disengagement' in others. Although this hypothesis cannot be ruled out, this last study demonstrates that at 33 months children use their knowledge about others' perceptual experiences to inform ignorant individuals (those who have *not* seen in a recent past) but not knowledgeable ones (those who *have* seen).

Informing and concealing information from others both require some understanding of how behaviour is influenced by people's knowledge of the true state of affairs, as well as an understanding of how knowledge is obtained through perceptual access. The following study investigated whether children at 36 months of age know how to adjust their behaviour to prevent others from acquiring visual and auditory information about ongoing transgressions. This would show that, at this age, children use their knowledge about others' perceptual experiences not only in a cooperative-communicative context by informing, but also in a deceptive one, namely to keep others ignorant about an ongoing transgression.

To examine whether children can conceal information in this way, we used the resistance-to-temptation paradigm, which is typically used for studying young children's deceptive abilities (Lewis *et al.*, 1989; Polak & Harris, 1999; Talwar, Gordon & Lee, 2007; Talwar & Lee, 2002, 2008). In this paradigm the child is left alone (or with a parent) in a room and is told not to peek at a toy; when the experimenter returns, the child is then questioned about whether or not she peeked. This paradigm may represent a more familiar and natural context for young children because in such cases deception comes naturally, and they therefore do not need to be explicitly instructed to be deceptive in the

context of a competitive game, as is the case in most other experimental paradigms for studying deception (e.g. Peskin, 1992; Gratch, 1964; Chandler, Fritz & Hala, 1989; Hala, Chandler & Fritz, 1991; Russell, Mauthner, Sharpe & Tidswell, 1991; Sodian, Taylor, Harris & Perner, 1991). Virtually all studies of resistance to temptation have operationalized deception as children's ability to verbally lie afterwards. Here, however, instead of asking children to lie or mislead others afterwards, we investigated their ability to conceal themselves from others during the prohibited action.

In the first study, we focused on 3-year-olds' ability to inhibit a prohibited action based on information about the attentional state of an adult. In previous studies using the resistance-to-temptation paradigm, only the presence/absence of the experimenter was manipulated. It is unclear what parameters children at this age use to decide when to break rules. Our goal was to investigate whether they have a more sophisticated understanding of the role of visual access in determining the behaviour and possibly informational state of others, and could consequently use more specific cues than mere presence/absence to intentionally inhibit their transgression. In the second study, we investigated children's ability to conceal auditory information from others. Specifically, children were given the opportunity to conceal an auditory cue that could potentially alert a nearby (but not looking) adult about their transgression. If, as other studies have shown, children of this age have developed some understanding about the relationship between perceptual access and knowledge, they should be successful at concealing both visual and auditory information that could inform an adult about their ongoing transgression.

## Experiment 1

The following experiment assessed whether 3-year-olds can use information about the attentional state of others to conceal a forbidden action. An adult experimenter told the children not to peek into a box: the child was supposed to wait so that both the experimenter and the child could look at the contents of the box together. We compared the children's tendency to peek prematurely when the adult either could or could not see them. We predicted that 3-year-olds would be sensitive to the adult's attentional state and would thus peek into the box more when the adult could not see them, and would thus use cues beyond the adult's presence or absence that indicate a lack of visual access.

### Method

#### Participants

Ninety-four children ranging between 34 and 38 months participated in this study. The participants belonged to a

database of parents who had volunteered to participate in studies of child development. Of these 94 children, 15 had to be excluded from the study because they did not comply with the experimenter's instructions from the beginning – leaving the room, looking into the box and/or playing with the toys in the box while the experimenter was still with them telling them not to peek<sup>1</sup>. We tested children until we had a similar proportion of boys and girls breaking the rule (i.e. peeking into the box in at least one condition). Of the final 79 children who complied with the experimenter's instructions, 39 (24 girls, 15 boys) never looked into the box (49%) and 40 (22 girls, 18 boys) (51%) looked into the box in at least one condition.

#### Materials

The following toys were used as surprises: a car, a train, a plastic object that made funny sounds, and a hand puppet. The surprises were kept inside identical colourful boxes (17 cm height, 23 cm length, 12 cm width), and each box was placed in a bright gift bag (32.5 cm height, 26.5 cm length, 14 cm width). The bags containing the surprises were kept inside a wooden box (41 cm height, 59 cm length, 43 cm width), which was covered by a piece of cloth and served as a table.

#### Procedure

Testing took place in a quiet room at the children's daycare. In a warm-up phase, the child and the experimenter (E) talked and played for about 10 minutes around the small wooden box, which served as a table. Children sat on a small chair in front of the experimenter.

In the testing phase, E told the child that she had a surprise for her and took one of the four gift bags out of the box. The experimenter helped the child to take the box containing the surprise out of the bag, but before the child could open the box and see its contents, E said: '*There is something really nice inside here and we are going to play with it soon but...*', then E said one of the sentences below depending on the condition, and, after leaving the box on top of the table with its lid half opened, E stood up and behaved in one of the following four ways.

1. Back-turned condition: After saying '*There is something really nice inside here and we are going to play with it soon but...* Oh, I forgot that I need to write something first, but wait, do not look inside the box until I'm back', E sat with her back turned 3–5m away from the table with the box. The child was sitting on the chair in front of the box. E continued writing with her back turned to the child for 3 minutes.

<sup>1</sup> It is unclear whether these children did not listen, did not pay attention to the experimenter, forgot about or just did not care about the prohibition

2. Looking-down condition: E said: '*There is something really nice inside here and we are going to play with it soon but...* Oh, I forgot that I need to finish writing something first, but wait, do not look inside the box until I'm back'. E sat 3–5m away from the table with the box, with her body facing the child but with her face facing down. E continued writing while facing down for 3 minutes.
3. Out condition: E said: '*There is something really nice inside here and we are going to play with it soon but...* Oh, I think I forgot something in the car, but wait, do not look inside the box until I'm back' and then left the room. E came back after 3 minutes.
4. Looking condition (control): E said: '*There is something really nice inside here and we are going to play with it soon but...* I need to make a phone call, but wait, do not look inside the box until I'm back' and sat 3–5m away from the table with the box, looking to the box and the child while having a phone conversation for 3 minutes.

After the 3 minutes, E approached the child and said: 'Ok, let's look what's in the box'. E and the child played for at least 3 minutes with the new toy and after this time a new trial started.

### Design

All children participated in all four conditions, receiving one trial per condition. The order of the conditions was counterbalanced across children, so that the number of times each condition was administered on a given position was counterbalanced across the final sample of children that looked into the box in at least one condition ( $n = 40$ ). The order of the surprises was also counterbalanced across children, so that each toy appeared the same number of times in a given position. A test session lasted between 35 and 45 minutes.

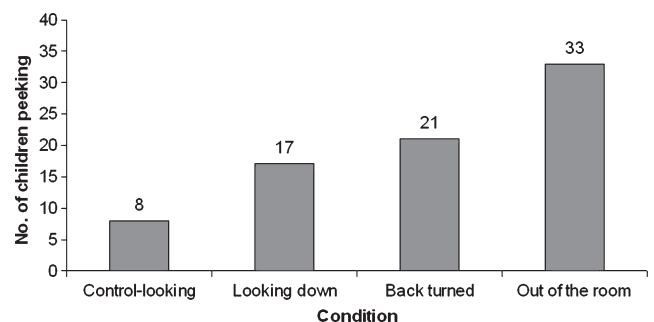
### Scoring

All experiments were recorded with a spy camera. Trials were coded live by a second experimenter watching the test online through a monitor connected to the camera. Trials were coded for whether or not children looked in the box and for the latency until children looked in the box. A trial started when E finished saying 'do not look inside the box until I'm back'. If the child stood up from the chair and/or leaned the body towards the box while directing their gaze to the opening of the box, this was scored as looking into the box. Twenty per cent of the trials were coded from the videotapes by a second coder. We used Cohen's kappa and Spearman correlation to test for the degree of agreement between coders. Reliability between the two coders was very good (Peeking behaviour:  $\kappa = .92$ ,  $n = 64$ ,  $p < .001$ ; latency to peek: Spearman's rho = .99,  $n = 14$ ,  $p < .001$ ).

For this experiment we used non-parametric statistical tests (i.e. Cochran, McNemar and Fisher tests) to compare performance across conditions.  $p$ -values were corrected following Hochberg (1988). Unless otherwise indicated, all analyses conducted are two-tailed. The analyses concerning whether or not the participants peeked into the box in a certain condition were one-tailed because, based on the many studies showing that by three years of age children have a sophisticated understanding about when others can see things (see Introduction), it was predicted that they would peek more in those conditions in which E was not looking than in the control condition.

### Results

Of the final 79 children that complied with the experimenter's instructions, 40 children (22 girls, 18 boys) (50.6%) looked into the box in at least one condition (these children looked while the experimenter was in the position typical for that condition and returned to their original starting position soon after peeking). Figure 1 shows the number of children who looked into the box in each of the four conditions. There were significant differences across conditions (Cochran's Q:  $\chi^2 = 32.5$ ,  $df = 3$ ,  $p < .001$ ). Children looked into the box significantly less often in the Looking (control) condition than in the Looking-down, Back and Out conditions (Looking versus Looking-down:  $p = .011$ ; vs. Back:  $p = .006$ ; vs. Out:  $p = .005$ ,  $n = 40$ , McNemar exact test, one-tailed). However, children also looked significantly less in the Back and Looking-down conditions than in the Out condition (Out versus Back:  $p = .012$ ; Out vs. Looking-down:  $p = .004$ ,  $n = 40$ , McNemar exact test, one-tailed). Because all children participated in all four conditions, it was possible that children looked in more than one condition. On average, children looked in two conditions ( $X = 2 \pm SEM = .16$ ). Children who looked in the control condition also looked in other conditions, and 4 of these 8 children looked in all conditions.

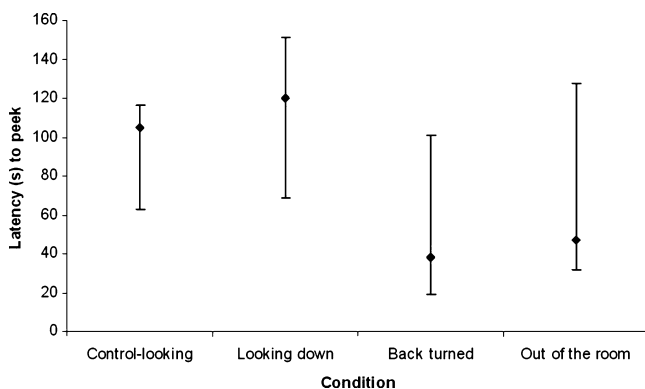


**Figure 1** Number of children who disobeyed the rule and looked into the box in each condition of Experiment 1. All children participated in the four conditions, receiving one trial per condition. Control vs. Looking-down, vs. Back-turned, vs. Out of the room ( $p < .05$ , McNemar's exact test, one-tailed).

In order to test for order effects we compared children's performance on a given condition at each sequential position. In general, no order effects were found with regard to children's tendency to peek into the box across the different sequential orders. Only in the back-turned condition did children peek into the box more often if this condition was conducted at the end of the test session (Fisher's exact test: Looking:  $p = .95$ ; Looking-down:  $p = .65$ ; Back:  $p = .03$ ; Out:  $p = .96$ ; two-tailed). We did not find any gender differences with regard to children's tendency to peek into the box (Fisher's exact test: Looking:  $p = 1$ ; Looking-down:  $p = .94$ ; Back:  $p = .95$ ; Out:  $p = .97$ ; exact, two-tailed). An analysis of children's latencies to peek into the box did not reveal any significant differences between conditions (6 Wilcoxon tests: average  $n = 9.3$ , range:  $n = 5$  to  $n = 17$ , all  $p > .23$ , no error-level correction applied, see Figure 2).

### Discussion

The results of this experiment revealed that children were more likely to peek inside the box when the experimenter could not see them than in a control condition in which she was looking at them. Children peeked into the box not only when the experimenter was not in the room, but also when she was in the room but did not have visual access to their activities. In the control condition in which the experimenter could see them, children correctly assessed that it was not 'safe' to peek into the box – even though the experimenter was busy talking on the phone. We also found that children peeked into the box significantly more often when the adult was not in the room than when she was in the room but could not see them. One possible explanation for this difference between experimental conditions is that the mere presence of the adult in the room led children to believe that she might have some source of access to their forbidden action. In other words, children might not completely understand that because the adult cannot *see*, she will also not know what they are doing. However, in our opinion, a more plausible



**Figure 2** Median latencies (and percentiles) to peek into the box in each condition. No significant differences across conditions were found.

explanation is that the children were afraid that the experimenter might stop her activities at any moment and then look at them. In addition, in the looking-down condition, it is conceivable that the child reasoned that the experimenter might be able to see their movements. Furthermore, they might also have reasoned that even if the experimenter could not see them, she could potentially hear their movements if they stood up to peek into the box. Therefore, in general it seems reasonable to perceive these two conditions as less safe and more 'risky' than the one in which the adult left the room.

Overall, these results support the hypothesis that 3-year-olds are able to use information not only about the presence/absence but also about the attentional states of others in order to inhibit a prohibited action. In the next experiment we investigated whether 3-year-olds also reason about others' auditory perception and are able to conceal auditory information from others.

### Experiment 2

This experiment investigated children's abilities to conceal an auditory cue that could potentially alert an adult about a transgression. The experimenter and the child played a guessing game, in which stuffed animals were hidden inside a toy house. The child was first encouraged to guess which animal was inside the house, and then allowed to look inside the house by opening one or both small doors located on its front side. One of the doors had bells hanging in front of it (noisy door), whereas the other had no bells, and thus could be opened without any noise (silent door). In the test condition, the experimenter moved behind a curtain so that she was unable to see the child, but they could still hear each other. The child was instructed not to look into the house until the experimenter came back. The question was whether children who were forbidden to look inside the house were more likely to use the silent door or employ any strategy that would prevent the bells from rattling than those who were given permission to do so. In contrast to the previous experiment, in which children had a choice between infringing a rule or not across different conditions (experimental and control), in this experiment children had to actively choose a strategy (silent versus noisy) during the act of breaking the rule. That is, children who chose to engage in the transgression had to decide further how best to do this. Therefore, we compared the prohibition condition to a permission condition (control) in which children were given permission to look inside the house, and therefore there was no reason for them to employ a silent strategy.

### Method

#### Participants

One hundred and seven children ranging between 34 and 38 months participated in this study. The children were

taken from a database of parents who had volunteered to participate in studies of child development. We tested 79 children in the prohibition condition and 28 (14 girls, 14 boys) in the permission condition. We tested children in the prohibition condition until we had a similar proportion of boys and girls breaking the rule (i.e. peeking into the toy house). From the 79 children, 11 had to be excluded from the study for not complying with the experimenter's instructions (as in the previous experiment), and three others had to be excluded owing to experimenter error. From the remaining 65 children, 36 (25 girls, 11 boys) never peeked into the house, and 29 (16 girls, 13 boys) disobeyed the adult experimenter, peeking into the house in her absence.

### Materials

The study took place in a quiet room (6.8 m × 2.7 m) that was divided into two parts by a big curtain. A colourful, wooden toy house (44 cm height, 36 cm width, 32 cm depth) was used as a hiding place for the stuffed animals. This house had two small doors (10 × 13 cm) on its front side. One of the doors (noisy) had small bells hanging in front of it, whereas the other door (silent) had a small plastic cube hanging in front of it. The position of the bells and the plastic cube (on the left or right door) could be changed across trials (see Figure 3). The left door opened to the left side and the right door to the right side. The stuffed animals were a horse, a cow, a duck, a frog, a rooster and a pig; all animal toys produced their characteristic animal sound when pressed.

### Procedure

Children were invited with their parents to a child observation laboratory. In a warm-up phase the child (accompanied by a parent) and the experimenter (E) first



**Figure 3** *Set-up of Experiment 2. Children who disobeyed the adult by peeking inside the house could choose to use the silent door (right door) or the noisy door (left door).*

talked and played for about 10 minutes in the observation room. E showed the child that the room was divided by the curtain into two parts. During this warm-up phase, E and the child played a game involving putting small plastic animal figures inside the toy house. The animals could go in and out of the house through two different doors positioned on the front of the house. In this warm-up phase, E commented to the child a couple of times that the door with the bells was loud. When the child seemed to be familiarized with the situation and the experimenter, the parent said that she needed to do something but would be back in a short while and left the room.

The test phase started with E proposing a fun game to the child in which the child was going to win many stamps. E and the child sat facing each other across a table with the toy house on top. E said that she was going to perform a magic trick in which an animal would appear inside the house; the child had to guess which animal it was.

1. Introduction: E said that she needed to close the curtains on the table (which occluded the toy house) to do her magic trick. E turned the house around, and, while hiding the stuffed animal, she pressed it so that the child could hear the animal-specific sound. Then E said: 'I'm ready!' and opened or asked the child to open the curtains. Next E asked the child 'what do you think is inside?' If the child didn't know or answer, E tried to help her by repeating the animal's sound. After guessing which animal it was, E allowed the child to look inside the house by opening one or both small doors on the front of the house. Then E exclaimed: 'Great!... You are so good, you've won a stamp for guessing right...'. If the child did not respond correctly, E helped her by saying not very loudly the correct answer so that the child could repeat it.
2. Test phase: As in the introduction, E closed the curtains while placing the animal in the house. While the animal was being hidden, she likewise activated the animal sound by pressing it. However, right after opening the curtains and before turning the house around, E exclaimed: 'Oh, I forgot I need to write something urgently over there' (pointing to the other side of the room, behind the curtain). Then E gave two different kinds of instructions depending on the condition:

Prohibition (experimental condition): 'but do not look yet inside'

Permission (control condition): 'if you want you can look inside'.

While in the other part of the room, E could watch the child online through a monitor connected to a spy video camera placed in the child's part of the room. E returned after a maximum of 3 minutes if the child did not peek into the house or after 20 seconds after the child had peeked into the house. Before coming back, she always

announced her return by saying: 'I've finished, I'm coming'.

### Design

Children were given 2–3 introduction trials to make sure that they answered (by guessing which animal it was) at least once. Children participated in either the experimental prohibition condition or the control permission condition. If the child did not look inside the house in the prohibition condition a second trial was conducted; otherwise, children participated in only one trial per condition. The position of the bells (left or right door) was counterbalanced across the final sample of children who broke the rule by peeking into the house in the prohibition condition and across all children who participated in the permission condition. A test session lasted approximately 20 minutes.

### Scoring and analysis

Trials were first coded for whether or not children peeked into the house. Trials in which children looked into the house were coded for the strategy that they used to open the door and peek inside the house. The criteria used to determine whether a child was using a silent strategy in order to avoid auditory attention were (1) the child opens the door without the bells, (2) the child opens either of the doors or even both of them but does so very carefully and ensures that the door with bells is opened only a little so that the bells do not ring, (3) the child carefully holds the bells with one hand to prevent them from ringing while opening the door with the other hand. If children (1) opened both doors simultaneously, or (2) opened the door with the bells letting the bells ring, this was scored as a loud opening. A trial started when E finished giving the instructions to peek or not to peek into the house. If a child looked more than once during the 3-minute interval, we coded the latency of the first look. All analyses were two-tailed because very little is known about children's understanding of others' auditory attention. A second coder coded 20 per cent of the trials using the videotapes. We used Cohen's kappa and Spearman correlation to test for the degree of agreement between coders. Reliability between the two coders was very good (peeking behaviour:  $\kappa = 1$ ,  $n = 14$ ,  $p < .001$ ; latency to peek: Spearman's  $\rho = .98$ ,  $n = 14$ ,  $p < .001$ ).

### Results

Of the final 65 children who complied with the experimenter's instructions in the prohibition condition, 36 never looked into the house (55%). The remaining 29 children (45%) disobeyed the adult experimenter by peeking into the house in her absence. Such looks always took place after the experimenter had disappeared behind the curtain. These children closed the house

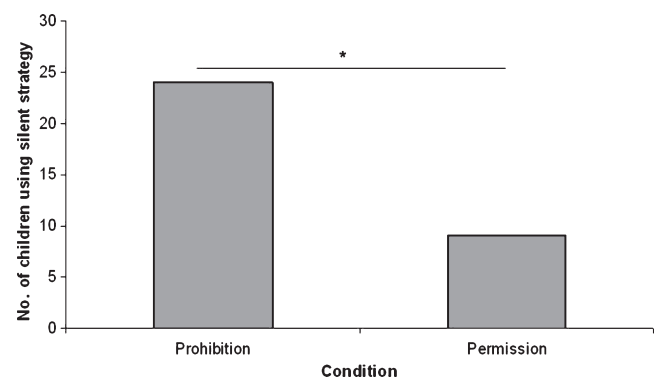
door(s) soon after peeking and continued waiting for the experimenter. Children in the prohibition condition used a silent strategy significantly more often than children in the permission condition ( $\chi^2(1, n = 57) = 12.97$ ,  $p < .001$ ; see Figure 4). In the prohibition condition, 24 children used a silent and 5 children a loud strategy, whereas in the permission condition, 9 children used a silent and 19 a loud strategy. Of the 29 children who peeked in the prohibition condition, 17 (59%) did so on the first and 12 (41%) on the second trial conducted. A second analysis including only those children who peeked in the first trial of the prohibition condition still revealed a significant difference in comparison to the strategy employed by children in the permission condition (Fisher's exact test:  $p = .02$ ).

The children's latency to peek into the house differed enormously between the two conditions (Man-Whitney  $U$ -test:  $U = 20.5$ ,  $n_{\text{prohibition}} = 29$ ,  $n_{\text{permission}} = 28$ ,  $p < .001$ ). In the permission condition, children looked into the house immediately after the experimenter finished telling them that they could do so if they wanted ( $X = 2 \text{ s} \pm 1 \text{ s}$ ), whereas in the prohibition condition this happened an average of 70 s ( $SEM = 10 \text{ s}$ ) after the start of a trial.

There were no gender differences with regard to the strategy children employed to peek into the house in either condition (prohibition: Fisher's exact test:  $p = .63$ ; permission: Fisher's exact test:  $p = 1.00$ ), or with regard to children's latency to peek into the house in the prohibition condition (Man-Whitney  $U$ -test:  $U = 103$ ,  $n_{\text{boys}} = 13$ ,  $n_{\text{girls}} = 16$ ,  $p = .97$ ).

### Discussion

In the current experiment the majority of the 3-year-olds attempted to refrain from making noise that a nearby adult might hear while engaging in a prohibited action. In contrast, they did not attempt to modulate the level of



**Figure 4** Numbers of children using a silent strategy to open the door in the prohibition and permission conditions of Experiment 2. Comparison between children who received the prohibition and those who received the permission condition: \*  $p < 0.001$ .

noise they produced when the same action was allowed by an adult. Although the experimenter was out of sight and thus could not see their actions, children chose to open the silent door or actively prevent the door's bells from ringing when they peeked into the toy house in the prohibition condition. This demonstrates that 3-year-olds understand that hearing is possible even with an obstructed line of sight between the perceiver and the stimulus (auditory cue). Furthermore, soon after peeking, the children closed the doors and continued waiting until the experimenter came back, implying that they understood that they were doing something they were not supposed to, and were intending to keep the adult unaware of their actions.

In contrast to the first experiment, in which children had a choice between infringing a rule or not, in this experiment children had to actively choose a strategy (silent versus noisy) during the act of breaking the rule. That is, by choosing a silent strategy, children were, to a certain extent, influencing, or at the very least controlling, the experimenter's perceptual experience. This experiment thus provides further support for the hypothesis that young 3-year-olds are able to use their knowledge about others' perceptual states to conceal not only visual but also auditory information from others.

## General discussion

The results of this study suggest that by three years of age children are able to inhibit and conceal an ongoing transgression, and that to do so they use information about what others can see and hear. Whether children disobeyed the experimenter's instructions in the first experiment depended on the attentional state of the adult – not just on her presence or absence, as in previous studies using the resistance-to-temptation paradigm. In the second experiment, children actively chose to conceal auditory cues that could alert the adult to their transgression.

As research on the development of visual perspective skills has shown, by 36 months of age children understand that others can see things that they cannot see, and vice versa. This study adds to previous findings by showing that children can spontaneously use this knowledge to inhibit a transgression when others can see them. The results of the second experiment further show that 3-year-olds' ability to conceal things from others is not restricted to the visual domain – they are able to actively choose a silent strategy when engaged in a prohibited action.

The simplest explanation for their ability to conceal their ongoing transgression is that children might have learned during their daily interactions how to avoid punishment and which specific cues best predict a certain behaviour from adults. For example, children might have learned that if adults are looking at them or if they are

loud in certain situations, they will most likely receive a punishment. This interpretation suggests that children are simply using their knowledge about perceptual states to avoid punishment. However, their ability to adjust their behaviour to the visual states of others is not restricted to this specific context of committing and concealing a transgression, because by this age they also know how to use this knowledge in a cooperative context, specifically to assess which individuals need to be updated or informed about something (Dunham *et al.*, 2000). Furthermore, in the present study children also performed well in the auditory modality. This suggests a broader level of understanding about how people become related to things through perceptual access, or a rudimentary understanding about the connection between perceptual access and informational state. Even though 3-year-olds lack an explicit understanding of the causal linkage between perceptual access and knowledge (as evidenced by the fact that they cannot report when others 'know' things based on their informational access: e.g. O'Neill, Astington, & Flavell, 1992; Wimmer, Hogrefe & Sodian, 1988), their implicit level of understanding allows them not only to adjust their behaviour to the perceptual access of others in order to communicate (Dunham *et al.*, 2000), but also to deprive others of visual and auditory information about an ongoing transgression.

Our results contrast with the findings of previous 'hide-and-seek' tasks that required concealment of an object (DeVries, 1970; Gratch, 1964; Shultz & Cloghesy, 1981). The competence of 3-year-olds in many of these studies was limited – they failed to keep the other person in an ignorant state about the location of an object. Because children were highly motivated to play the game, their incompetence has been interpreted as a lack of insight into the causal relationship between informational access and knowledge, and therefore as an inability to withhold information and manipulate others' knowledge states (Wimmer, Hogrefe & Perner, 1988). Alternatively, children younger than four may have problems understanding the nature of competitive games, or they may lack the motivation to engage in them in the way older children or adults do (Wellman, 1990; Peskin, 1992). In fact, in the hand-guessing game studies by Gratch (1964) and de Vries (1970), in which children were supposed to hide a marble in one hand, many of the children could not be brought to hide the marble at all. Furthermore, many of the children who did hide the marble then showed it to the experimenter as soon as she started guessing in which hand it was. In a pilot study we conducted prior to the experiments reported here, we encountered similar problems with 3-year-olds. Children were supposed to play a competitive game against an adult, hiding their approach to obtain an object that both the experimenter and the child wanted. Children seemed not to understand the goal of the game, and appeared to enjoy it when the experimenter discovered them approaching the object,



and took it away from them (see LaFreniere, 1988 for similar reports). Some children insisted on changing the rules, switching roles with the experimenter or alternating who received the object. Thus, for these children, the goal of the game was not obtaining the object by outwitting the adult, but rather a positive, playful interaction with the adult.

Our interpretation, however, contrasts with that of Sodian (1991), who found that children's difficulty employing deceptive means was not with the competitive aim characteristic of the 'hide-and-seek' tasks. In her study, children were motivated and able to outwit the adult competitor by using sabotage means, such as physical obstruction, but unable to employ deceptive means, such as lying or deceptive pointing. Nevertheless, although children were more likely to practise sabotage than deceptive means, the proportion of 3-year-olds who employed sabotage means was only 50%. Furthermore, in the deception condition, children were required to provide false information to the competitor rather than concealing perceptual information from him, and the former may be more cognitively complex than the latter. In other words, if children at this age can successfully occlude things from others if asked to do so (e.g. Lempers *et al.*, 1977), one possible reason for their failure in previous 'hide-and-seek' games is not a lack of understanding about how to deprive others of perceptual information, but a lack of motivation to do so and thus to play the game as it is conceived by the adult. In addition, some of the previous studies might have used games or tasks that are harder and cognitively more demanding (e.g. those in which children are required to provide false information). Therefore, our hypothesis is that a more psychologically relevant procedure (i.e. the resistance-to-temptation paradigm) may be better able to tap into 3-year-olds' hiding abilities.

It is important to emphasize that the present study has only investigated children's ability to conceal an *ongoing* transgression. A higher level of difficulty would be to conceal certain types of information *after* the transgression had already occurred, so that others cannot infer one's past actions. Anecdotal evidence from this study suggests that children were careful enough to leave the object in its initial position after touching it (or after looking inside the toy house). However, studies in which children are instructed to conceal visual traces so that a competitor would not find a hidden object have mostly produced negative results (e.g. Sodian *et al.*, 1991; although see Chandler *et al.*, 1989). Similarly, although 3-year-olds can deny a misdemeanor after a transgression, such as peeking at an object, they seem to be unable to conceal information about their own interests, intentions, or knowledge (Peskin, 1992; Polak & Harris, 1999; Talwar & Lee, 2008). In the studies conducted by Polak and Harris (1999) and Talwar and Lee (2008), children falsely denied having peeked at the toy, but were unable to feign ignorance when asked about the identity of the toy. The

ability to maintain a lie by feigning ignorance has been linked to second-order belief understanding (Polak & Harris, 1999; Talwar & Lee, 2002), as the child has to reason about what the other person will be able to infer and think from any knowledge the child reveals. New studies by Talwar *et al.* (2007) and Talwar & Lee (2008) support this hypothesis.

One surprising finding was that in both of our experiments only around 50% of the participants committed the transgression in the first place (peeked at the toy). The majority of previous studies using the resistance-to-temptation paradigm reported higher proportions of children committing the transgression (Talwar & Lee, 2002: 82%; Lewis *et al.*, 1989: 88%; Polak & Harris, 1999: 54% and 95% in experiments 1 and 2, respectively). A possible explanation for this difference in children's transgression rates could be related to slight methodological differences. For example, in the studies conducted by Lewis *et al.* (1989) and Talwar and Lee (2002, 2008) children only had to turn around in order to peek at the toy, whereas in our experiments peeking at the toy involved arguably more effort and a more 'risky' action (i.e. standing up a little bit from the chair and opening a door in the toy house in the first and second experiments, respectively). In support of this explanation, Polak and Harris (1999) report two experiments with very different transgression rates: in the first one the transgression consisted of touching a toy, and the proportion of noncompliant children was 54% (i.e. similar to ours), whereas in the second experiment the transgression consisted of peeking at a toy inside a house, and to do this children only had to twist their neck and upper body (since the house's door was open). In this latter experiment the proportion of noncompliant children was 95%. This suggests that the specific type of action necessary to commit the transgression has an important effect on children's tendency to comply with the rule. This explanation can also be put forward to explain differences in latencies to commit the transgression. The latencies we found are higher than those found by Talwar and Lee (2008), whose participants only had to turn around in order to peek at the toy, but are similar to or lower than those found by Polak and Harris (1999) in the condition in which the transgression consisted of touching a toy. The focus of our study, however, was not on the tendency to engage in a transgression but instead on the mechanism employed while engaged in a transgression.

To conclude, 3-year-olds not only know when others can perceive things, but also are able to use this knowledge to conceal an ongoing transgression. Concealment or the ability to deprive others of visual and auditory information about an ongoing activity seems thus to develop around one year earlier than the ability to engage in other forms of deception. Previous studies of young children's deceptive abilities have mostly required them to engage in some form of active misleading in which they provide others with information

they know to be false (Chandler *et al.*, 1989; Hala *et al.*, 1991; Ruffman, Olson, Ash & Keenan, 1993; Russell *et al.*, 1991; Sodian, 1991; Sodian *et al.*, 1991). The majority of these studies have found that children younger than 4 years of age (i.e. the age at which they pass standard false-belief tasks) cannot actively mislead as a way of creating false beliefs in others (although see Chandler *et al.* 1989; Hala *et al.*, 1991). The present findings therefore contribute to the study of the development of deception in children by showing that, one year before that, children use their knowledge of others' perceptual states to keep them ignorant about an ongoing transgression, showing the capacity to influence others' informational states when it is in their own advantage to do so.

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