Journal of Experimental Child Psychology xxx (xxxx) xxx

Contents lists available at ScienceDirect

Journal of Experimental Child Psychology

journal homepage: www.elsevier.com/locate/jecp

Are you watching me? The role of audience and object novelty in overimitation

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ARTICLE INFO

Article history:
Received 20 March 2018
Revised 20 December 2018
Available online xxxx

Keywords:
Overimitation
Audience effect
Causal reasoning
Social signalling
Ostracism
Object Novelty

ABSTRACT

This study tested whether overimitation is subject to an audience effect, and whether it is modulated by object novelty. A sample of 86 4- to 11-year-old children watched a demonstrator open novel and familiar boxes using sequences of necessary and unnecessary actions. The experimenter then observed the children, turned away, or left the room while the children opened the box. Children copied unnecessary actions more when the experimenter watched or when she left, but they copied less when she turned away. This parallels infant studies suggesting that turning away is interpreted as a signal of disengagement. Children displayed increased overimitation and reduced efficiency discrimination when opening novel boxes compared with familiar boxes. These data provide important evidence that object novelty is a critical component of overimitation.

Introduction

Children are predisposed to copy the actions of others with high fidelity even when they are visibly unnecessary (Lyons, Damrosch, Lin, Macris, & Keil, 2011; Lyons, Young, & Keil, 2007). Strikingly, this "overimitation" is pervasive, occurring when children are directly instructed to complete only necessary actions (Lyons et al., 2007) and when unnecessary actions are performed on simple familiar

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https://doi.org/10.1016/j.jecp.2018.12.010
0022-0965/© 2018 Published by Elsevier Inc.

objects (Marsh, Ropar, & Hamilton, 2014). Despite a decade of research, there is little consensus on why children engage in overimitation.

Social signaling theory suggests that overimitation is akin to mimicry and serves as a signal to others, conveying likeness or willingness to interact. Consistently, children overimitate more in scenarios that have increased social relevance to them (Marsh et al., 2014; Nielsen, 2006; Nielsen & Blank, 2011; Nielsen, Simcock, & Jenkins, 2008; Over & Carpenter, 2009). However, evidence suggests that overimitation also occurs in the absence of social drivers (Whiten, Allan, Devlin, Kseib, & Raw, 2016) and regardless of whether irrelevant actions are demonstrated communicatively or noncommunicatively (Hoehl, Zettersten, Schleihauf, Grätz, & Pauen, 2014). Failures in causal encoding may also play a role in overimitation (Lyons et al., 2007, 2011), and overimitation increases with task opacity (Burdett, McGuigan, Harrison, & Whiten, 2018). However, causal misunderstanding is unlikely to be the sole determinant given that overimitation increases with age and into adulthood when causal reasoning is fully matured (Marsh et al., 2014; McGuigan, Makinson, & Whiten, 2011; Whiten et al., 2016). Alternatively, overimitation could reflect a bias to generate and defer to normative rules when observing intentional actions (Kenward, 2012; Kenward, Karlsson, & Persson, 2011; Keupp, Behne, & Rakoczy, 2013; Schmidt, Rakoczy, & Tomasello, 2011). However, it remains unclear whether children defer to norms because they are driven to *signal* their similarity to others or because they find it intrinsically rewarding to do so regardless of whether a social signal is sent. Evolutionary accounts propose that overimitation is adaptive; by copying when uncertain and refining one's behavioral repertoire later, imitation serves dual functions of learning about the causal properties of objects in addition to learning social conventions (Burdett et al., 2018; Wood et al., 2016). Each of these theories is supported by a strong set of studies but is also refuted by others, leading to an empirical impasse. A potential explanation for this lack of consensus is that two key features of experimental paradigms used to study overimitation have varied between studies: the audience during the response phase and the complexity of objects used in overimitation tasks. This study sought to systematically manipulate these factors within a single study to examine their impact on overimitation.

People change their behavior under conditions in which they feel like they are being observed, and this audience effect has been linked to a change in self-focus or reputation management (Bond & Titus, 1983). Audience effects have been studied in many domains, but recently there has been an increased focus on audience effects as a marker of reputation management (Izuma, Matsumoto, Camerer, & Adolphs, 2011) or social signaling (Hamilton & Lind, 2016). If overimitation is a signaling phenomenon, then it should be modulated by the presence of an audience because it is not worth sending a signal if there is no audience available to perceive it. However, if overimitation reflects a learning process (either causal or normative rules), then the demonstration phase of the study when children gain new information about the task is critical. If children extract a causal or normative rule from the demonstration, then they will faithfully replicate the demonstration regardless of their audience. There are methodological differences in previous overimitation studies regarding whether the participants are observed during the response phase. In some studies children were directly observed by the demonstrator (Nielsen, 2006; Nielsen & Blank, 2011) or by a separate experimenter (Burdett et al., 2018; Marsh et al., 2014; Wood et al., 2016), but in other studies the demonstrator turned his or her back on the children during their response (Keupp et al., 2013) or left the children entirely alone (Hoehl et al., 2014; Kenward et al., 2011; Lyons et al., 2007, 2011; Schleihauf, Graetz, Pauen, & Hoehl, 2018). To date, no single study has directly compared these conditions. In this study, we directly compared the rates of overimitation when children are alone, when they are in the presence of a demonstrator who turns his or her back on the participants, or when their actions are directly observed.

A second research question relevant to overimitation is the extent to which the type of object used in a given study influences our estimates of overimitation. Tasks used to elicit overimitation vary with regard to the type of objects and tools that are used, ranging from simple familiar objects to complicated puzzle boxes (see Marsh et al. (2014) and Taniguchi & Sanefuji (2017) for discussions), although the puzzle box designed by Horner and Whiten (2005) has dominated the field. Traditionally, overimitation was demonstrated by comparing rates of imitation on transparent and opaque puzzle boxes under the assumption that the causal properties of a puzzle box are apparent if it is transparent. Indeed, research suggests that imitation is more prevalent when interacting with an opaque puzzle box compared with an otherwise identical but transparent box (Burdett et al., 2018; Horner &

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Whiten, 2005), although manipulating the opacity of the reward container had no effect (Schleihauf et al., 2018). These studies used novel puzzle boxes, but we posit that encountering any novel object is likely to cause some uncertainty about the way in which it is operated regardless of its physical transparency. This uncertainty may lead to increased overimitation (Rendell et al., 2011; Wood et al., 2016). Here we examined the effects of object novelty on overimitation and uncertainty by directly comparing overimitation on matched novel and familiar boxes while also examining children's understanding of the efficiency of the actions the children witness. If a "copy when uncertain" bias is present, then we predict reduced efficiency discrimination for novel objects and a corresponding increase in overimitation.

Method

Participants

A sample of 86 4- to 11-year-old children were randomly assigned to one of three experimental conditions (see Table 1). The sample was recruited and tested at the University of Nottingham Summer Scientists event, which attracts middle-class families from a mid-sized city in England.

Stimuli

Two sets of six puzzle boxes were used: a novel set and a familiar set. Each box was a simple transparent container with a removable lid; there were no hidden mechanisms or latches. In the familiar set, the boxes were not modified further. In the novel set, identical boxes were slightly modified to create a simple box that participants had not encountered before. Buttons, switches, or additional decorations were added to each box (see Fig. S1 in online supplementary material). Importantly, none of these decorations changed the function of the boxes, but we anticipated that these decorations would affect children's certainty about how the objects should be operated. A small toy was put inside each box for children to retrieve.

Design

This study adopted a 3 × 2 mixed design, with children randomly assigned to one of three between-participants audience conditions: Act Alone, Disengagement, or Audience. Object novelty was manipulated within participant. To rule out poor memory as an explanation for why young children overimitate less, a memory control task was included. Four of the six boxes were selected to be the overimitation trials (two novel and two familiar), and two boxes were selected to be memory trials (one novel and one familiar). Boxes were counterbalanced for novelty and task between participants.

Procedure

Testing took place in a partitioned section of a room introduced to children as a "den." Poster boards and colored fabric were arranged such that the den was not visible to anyone waiting outside. A hidden camera was positioned behind a hole in the fabric wall to record the sessions without

Table 1
Means (and standard deviations) for randomly assigned experimental conditions and *p* values for differences among groups.

	Act Alone (n = 26)	Disengagement (n = 30)	Audience (n = 30)	Difference (p)
Age	6.84 (1.82)	7.58 (2.45)	7.33 (2.04)	.43
Efficiency Discrimination	2.36 (1.44)	1.99 (1.72)	2.45 (1.22)	.44
Memory	1.81 (0.40)	1.70 (0.53)	1.60 (0.62)	.35
Overimitation	2.77 (1.42)	1.83 (1.64)	2.77 (1.43)	.03*

Note. There were 12 girls (46%) in the Act Alone condition, 16 girls (53%) in the Disengagement condition, and 17 girls (57%) in the Audience condition.
* $p<.05$

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children's awareness (see Fig. S2). Children were tested alone, with parents waiting in the room outside. They sat at a small table, opposite the experimenter, and completed a warm-up task (see supplementary material) before completing three experimental tasks in a fixed order.

Overimitation task

The experimenter demonstrated a sequence of three actions (two necessary and one unnecessary) to open the box and retrieve the object (see supplementary material for verbatim instructions and details of the actions). The experimenter then reset the box behind a screen and handed it to the child with this instruction: "When I say 'GO,' I would like you to get the [duck] out of the box as quickly as you can." In the Act Alone condition, the experimenter left the den, shut the door behind her, and called "GO" to the child to signal the start of his or her turn. In the Disengagement condition, the experimenter turned around in her seat, called "GO," and sat still facing away from the child until the box had been opened. In the Audience condition, the experimenter called "GO" and continued to sit and watch the child while he or she retrieved the object. This sequence of events was repeated for four overimitation trials.

Memory task

Children completed a warm-up copying task before watching the experimenter open two more boxes (see supplementary material). The memory trials were completed under the same audience conditions as the overimitation trials, so the child was instructed, "When I say 'GO,' can you get the [duck] out of the box. Remember to copy me exactly."

Efficiency discrimination task

Children rated the efficiency of one necessary action and one unnecessary action from each trial on a scale from 1 (*very sensible*) to 5 (*very silly*) as described in Marsh et al. (2014) (see also supplementary material). Efficiency discrimination scores were calculated by subtracting the unnecessary action rating from the necessary action rating on each trial. This score could range from −4 (poor efficiency discrimination) to +4 (good efficiency discrimination), with a zero (0) score indicating no discrimination.

Data coding and analysis

All responses were coded from video. Overimitation on each trial was coded as 1 if the child made a definite and purposeful attempt to replicate the unnecessary action described in Table S1 in the supplementary material or was coded as 0 otherwise. The same criterion was applied to the memory trials, and a total memory score was calculated for each child. Preliminary analyses showed that overimitation did not vary as a function of trial order, $F(3, 343) = 1.85$, $p = .138$, or puzzle box, $F(5, 343) = 0.421$, $p = .834$), so these variables are not considered further. Mixed-effects models were run using the lme4 package (Bates, Mächler, Bolker, & Walker, 2015) and the MuMIn package (Barton, 2013) in R (Version 3.4.2). Separate models were used to predict propensity to overimitate and efficiency discrimination scores. For overimitation, a full model was constructed that included predictors of interest (audience, novelty, and efficiency discrimination) and control predictors (age, gender, and memory) as fixed effects plus an audience by novelty interaction. Random intercepts for child ID were included to account for the nested structure of the data. The full model was compared with a null model that included only control predictors and random effects using a likelihood ratio test. If the full model outperformed the null model (i.e., a significant difference in model fit), then a reduced model (full model minus the interaction term) was compared with the full model to ascertain whether the interaction term significantly contributed. Efficiency discrimination scores were analyzed using the same protocol. The full model included predictors of interest (age and novelty), control predictors (gender and memory), and random effects (child ID). The full model was compared with a null model (control predictors + random effects) using a likelihood ratio test.

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Results

Children in each of the three experimental conditions were matched for age (see Table 1). The rate of overimitation was high, with 80.2% of children overimitating on at least one trial. Memory scores were also high, with 73.3% of children performing at ceiling. Only 3.5% of children scored 0 (see Table 1).

The reduced model was the best fit to the overimitation data, explaining 12.0% of the variance by fixed effects and 69.3% of the variance by random effects (see Tables S3 and S4 for model summaries and comparisons). Audience was a significant predictor of overimitation, $\chi^2(2) = 7.85$, $p = .020$. Children in the Disengagement condition ($M = 1.83$, $SD = 1.64$) overimitated less than those in the Audience condition ($M = 2.77$, $SD = 1.43$, odds ratio = 7.82, 95% confidence interval [CI] = [1.63–50.66]) and Act Alone condition ($M = 2.77$, $SD = 1.42$, odds ratio = 6.34, 95% CI = [1.23–42.68]). There was no difference between the Audience and Act Alone conditions (odds ratio = 1.23, 95% CI = [0.22–7.51]). Novelty also significantly predicted overimitation, $\chi^2(1) = 6.04$, $p = .014$, such that unnecessary actions on familiar objects ($M = 1.13$, $SD = 0.88$) were imitated less frequently than unnecessary actions on novel objects ($M = 1.31$, $SD = 0.88$, odds ratio = 0.46, 95% CI = [0.24–0.86]) (see Fig. 1). Age, gender, efficiency discrimination, and memory did not predict overimitation (see Table S3). There was no interaction between audience and novelty, $\chi^2(2) = 0.20$, $p = .905$, indicating that novelty had the same effect on overimitation behavior regardless of audience.

The full model best predicted the efficiency discrimination data, explaining 10.6% of the variance with fixed effects and 54.2% with random effects (see Tables S4 and S5 for model comparisons and model summaries). Age predicted efficiency discrimination, $\chi^2(1) = 13.33$, $p < .01$, such that the older children were better at discriminating necessary and unnecessary actions compared with the younger children (odds ratio = 1.68, 95% CI = [1.28–2.20]). Novelty also predicted efficiency discrimination, $\chi^2(1) = 4.30$, $p = .038$. Children were worse at discriminating the efficiency of necessary and unnecessary actions when objects were novel ($M = 2.20$, $SD = 1.85$) compared with when they were familiar ($M = 2.44$, $SD = 1.88$, odds ratio = 1.26, 95% CI = [1.01–1.57]). There was no effect of gender or memory on efficiency discrimination scores (see Table S5).

Discussion

The effect of audience on overimitation was assessed for novel and familiar objects across a broad developmental spectrum. We demonstrate a clear effect of audience, but not an increase with increasing level of observation (i.e., Audience > Disengagement > Act Alone). Instead, we report similar levels

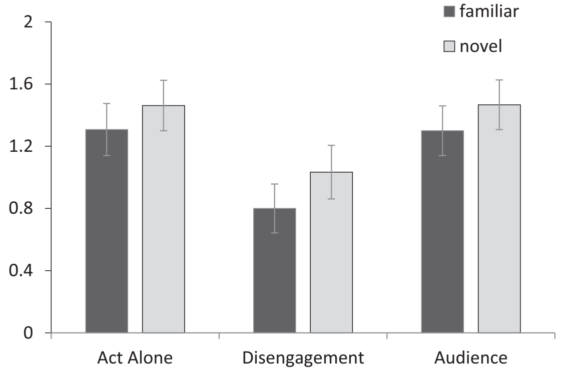

Fig. 1. Mean number of actions overimitated (out of 2) as a function of experimental condition (Act Alone, Disengagement, or Audience). Dark bars indicate familiar objects, and light bars indicate novel objects. Error bars represent ±1 standard error of the mean.

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of overimitation when children were observed and when they were alone, but reduced imitation when the demonstrator turned away. This intriguing set of results can be explained in two ways.

First, we could argue that an audience effect was found in the Audience > Disengagement comparison but that some distinctive feature of the Act Alone condition disrupted this pattern. High levels of overimitation in the Act Alone condition could be explained by an ''omniscient adult phenomenon" or ''Monika effect," whereby children falsely attribute knowledge to unseen adults (Wimmer, Hogrefe, & Perner, 1988). When children were left alone, perhaps they were uncertain about whether they were being observed and, by default, acted as though they were. This mirrors other findings in developmental psychology (Meristo & Surian, 2013; Rubio-Fernández & Geurts, 2013). Children expect a third party to act consistently with the children's knowledge even if there is no evidence that the third party shares this knowledge. However, if children are provided with direct evidence that a third party does not share the same knowledge, they will predict behavior based on the agent's knowledge. For example, Rubio-Fernández and Geurts (2013) demonstrated that 3-year-olds passed a standard false-belief task when the protagonist turned her back (giving direct evidence that the protagonist could not see the location change) but failed when the protagonist left the scene entirely (see also Meristo & Surian, 2013). Perhaps this bias extended to the children in our study. When children had direct evidence that they were not being watched (Disengagement condition), they reduced their overimitation. However, when there was no such evidence (Act Alone condition), they assumed that they were observable and acted similarly to those children who were directly observed (Audience condition). These findings hint toward an interesting distinction in our processing of others' minds when those individuals are physically present, but not watching, and when they are completely absent.

An alternative interpretation is that there was a reduction in overimitation in the Disengagement condition because the experimenter's actions caused the children to feel less rapport or motivation to engage. By turning her back on the children as they acted without excusing herself, the experimenter gave a strong signal of disinterest that could be interpreted as ostracism (Wirth, Sacco, Hugenberg, & Williams, 2010). As a result, the children may experience reduced rapport with the experimenter and, thus, a reduced drive to overimitate (Nielsen, 2006). This is contrary to several other findings indicating that children actually increase their imitative fidelity following exposure to third-party experience of ostracism (Over & Carpenter, 2009; Watson-Jones, Legare, Whitehouse, & Clegg, 2014) and first-person experience of ostracism (Watson-Jones, Whitehouse, & Legare, 2016). However, previous work primed ostracism indirectly via computer animations, which do not directly depict the demonstrator, prior to the imitation task. It is possible that disengagement from a live model during the interaction has the opposite effect on imitation due to either the proximity or time course of ostracism. Further work is needed to disentangle these effects. A neater direct test of the ostracism account could be to compare rates of imitation when the experimenter excuses herself and turns around to complete a task with those when the experimenter simply disengages without excuse (as in this study).

Both interpretations are consistent with the signaling theory of overimitation, in which children are motivated to send a signal to people who are watching and with whom they have a rapport. The data may also be consistent with a normative account in which children opt to disregard the newly learned norm following ostracism, although further research examining the flexibility of norm adherence is required to support this argument. However, it is not clear how causal encoding can account for the differences among the three social conditions in this study.

Another striking finding was that children were more likely to overimitate and were less able to discriminate the efficiency of actions when interacting with a novel box compared with a familiar box. Thus, it seems that altering the perceived novelty of the boxes reduced children's certainty about the causal properties of the objects, leading children to overimitate more even though only very minor decorative changes distinguished familiar and novel boxes. This is consistent with emerging work that illustrates increased overimitation when task complexity increases (Taniguchi & Sanefuji, 2017). These results reflect an element of causal understanding in any overimitation task, and using novel objects can contaminate social effects. Alternatively, it is possible that the children in this study interpreted the novel boxes in this task as more playful, which led them to copy more and rate the unnecessary actions as less ''silly." However, given that the object novelty manipulation was presented within participant and in a randomized order, it is unlikely that the children interpreted the exact same instructions differently on each trial. Regardless, previous studies have varied in the use of transparent and

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opaque puzzle boxes, with some including redundant mechanisms, hidden catches, and superfluous decorations. This lack of consistency increases response variability and could account for the disparity in results from different labs. We stress that future work examining the social effects of overimitation should carefully evaluate the findings with regard to the type of objects that have been used to elicit overimitation.

To conclude, this study provides evidence that observation of participants during their response and stimulus familiarity can affect overimitation. These factors may account for discrepancies among previous studies. The finding that children reduce overimitation when the experimenter disengages is consistent with social signaling and social rapport accounts of overimitation, and we look forward to further studies that distinguish these motivating factors.

Acknowledgments

L.E.M. was supported by a research fellowship from the University of Nottingham, and A.F.d.C.H. was supported by European Research Council (ERC) Grant INTERACT 313398. We thank the organizers of Summer Scientists Week and all of the families who took part in this research.

Appendix A. Supplementary material

Supplementary data to this article can be found online at https://doi.org/10.1016/j.jecp.2018.12.010.

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