Cognitive Dissonance from 2 years of age:
Toddlers', but not infants', blind choices induce preferences

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Abstract

As adults, not only do we choose what we prefer, we also tend to adapt our preferences according to our previous choices. We do this even when our choices were blind and we could not have had any previous preference for the option we chose. These blind choice-induced preferences are thought to result from cognitive dissonance as an effort to reconcile our choices and values. In the present preregistered study, we asked when this phenomenon develops. We reasoned that cognitive dissonance may emerge around 2 years of age in connection with the development of children's self-concept. We presented N=200 children aged 16 to 36 months with a blind choice between two toys, and then tested whether their choice had induced a preference for the chosen, and a devaluation of the discarded, toy. Indeed, children's choice-induced preferences substantially increased with age. 26- to 36-months-old children preferred a neutral over the previously blindly discarded toy, but the previously chosen over the neutral toy, in line with cognitive dissonance predictions. Younger infants showed evidence against such blind choice-induced preferences, indicating its emergence around 2 years of age. Contrary to our hypotheses, the emergence of blind choice-induced preferences was not related to measures of self-concept development in the second year of life. Our results suggest that cognitive dissonance develops around 2 years. We speculate about cognitive mechanisms that underlie this development, including later-developing aspects of the self-concept and increasingly abstract representational abilities.

Keywords

Cognitive dissonance, Choice-induced preferences, Blind choice, Decision-making, Infants, Development, Self-concept

Introduction

It is intuitive that our choices are based on our values and preferences. When confronted with the decision of which color sweater to buy, or which meal to order in a restaurant, out of several options, we typically pick the one we prefer. It has been shown, however, that we do not only choose what we prefer, but we also prefer what we choose: We tend to adapt our preferences to what we have already chosen. Critically, we do so even if we had no initial preference for the chosen option, but were forced to choose one of them (Brehm, 1956; Festinger, 1957; Enisman, Shpitzer, Kleiman, 2021). Such choice-induced preferences have been argued to result from an effort to reduce *cognitive dissonance* – an inner discomfort thought to arise when our choices are incongruent with our preferences or values (Festinger, 1957). By aligning our preferences with our choices, even after making the choice, our behavior and values can be made congruent again, and dissonance can be reduced. For example, when participants are forced to choose between two options that they initially rated as equally attractive, as a consequence of their choice, they devalue the discarded option and increase their rating of the chosen option (e.g., Brehm, 1956). Critically, it has been shown that this is even the case when their choice is blind (i.e., when the chooser did not know the options from which they were choosing, e.g., Sharot et al., 2010; Izuma & Murayama, 2013; Enisman, Shpitzer, Kleiman, 2021). The blind-choice experiments demonstrate that the observed preferences are a true consequence of the act of choosing itself, and cannot reflect any initial preference that might have guided the participant's choice (Chen & Risen, 2010; Izuma & Murayama, 2013). Blind choice-induced preferences are therefore considered the critical test of cognitive dissonance.

Cognitive dissonance theory has generated a wealth of empirical research and theory (for a review see e.g., Harmon-Jones & Mills, 2019). Since the 1950s, an overwhelming body of research has confirmed choice-induced preferences and other cognitive dissonance phenomena in adults. While being one of the most studied theories in modern social psychology, research has only recently embarked on trying to understand its ontogeny in human development (Egan, Santos, Bloom, 2007; Egan, Bloom, Santos, 2010; Silver et al, 2020). Moreover, after more than 60 years of research and theory building on this phenomenon, its underlying cognitive mechanisms are still hotly debated (e.g., Harmon-Jones, 2019; Cooper, 2007, 2019; McGrath, 2017). In the present study, we aimed to achieve a better understanding of when choice-induced preferences develop and how they relate to other domains of cognitive development. In particular, we hypothesized that there may be a relationship between emerging cognitive dissonance and self-awareness.

Prominent accounts have argued that the self-concept plays a crucial role in this phenomenon (e.g., Aronson, 1968; Steele, 1988). For example, it has been proposed that dissonance is only caused by conflicting cognitions that are related to the self-concept (Aronson, 1968) or that threaten the self-integrity (Steele & Liu, 1983; Steele, 1988). Support for such suggestions comes from findings that cognitive dissonance phenomena in adults are affected by participants' self-esteem (e.g., Stone, 1999; Cooper, 2007) and that threats to the self-image are compensated by self-affirmation in related or even unrelated domains (e.g., Steele & Liu, 1983; McQueen & Klein, 2006). From a developmental perspective, we reasoned that perceiving a conflict between one's own preferences and choices should require at least a basic concept of the self as a unit to which these preferences and behavior can be attributed. That is, if the action of choosing and one's own preference were not attributed to the same entity (namely the self), there should be no conflict between the two, and consequently no cognitive dissonance should arise that would need to be reduced. In the current study, we therefore set out to investigate whether the development of choice-induced preferences is related to developments of the self-concept in early childhood.

Three studies indicate that children display choice-induced preferences in line with cognitive dissonance theory by late preschool-age (Aronson & Carlsmith, 1963; Egan et al., 2007, 2010). Five-year-old children were shown to devalue a toy after deciding not to play with it following a mild warning, but not a strong warning, by an adult (Aronson & Carlsmith, 1963). Indeed, the mild warning had been assumed to leave children more choice whether to avoid the toy or not, and thus to be more likely to produce cognitive dissonance. In a more direct test of choice-induced preferences, Egan and colleagues showed that 4-year-olds, as well as capuchin monkeys, ended up avoiding a toy that they had previously discarded, but did not show this behavior in a control condition where they had been assigned one of two toys without giving them the choice (Egan et al., 2007). Importantly, they also showed this preference when their initial choice had been blind (Egan et al. 2010), demonstrating that their preferences had indeed been induced by their choices *per se*, and could not have resulted from any initial preference for one toy over the other toy (see e.g., Chen & Risen, 2010; Izuma & Murayama, 2013). Taken together, these studies convincingly show that choice-induced preferences are present from at least 4 years of age, raising the question when this phenomenon develops. Recently, choice-related preferences were also observed in preverbal infants aged between 10 and 20 months (Silver et al., 2020). While infants avoided a previously unchosen toy when they had been able to see the objects in their initial choice, this preference disappeared when infants' chose blindly, without knowing the objects' identity. This left open the possibility that infants' choices and preferences reflected actual initial preferences rather than being induced by cognitive dissonance (e.g., Chen & Risen, 2010; Egan et al., 2010; Izuma & Murayama, 2013). In a follow-up study, Silver et al. (2020) showed that infants also avoided a toy they had previously chosen when tricked into believing that they had discarded this toy. This indicates that the observed preferences did not merely reflect their actual initial preference, but might indeed have resulted from what the infants believed to have been their choice. Why then did infants not show choice-induced preference changes in case of a *blind* choice, as adults and older children do (Egan et al., 2010; Sharot et al., 2010)? As blind choice-induced preferences are considered the critical test of cognitive dissonance (e.g., Chen & Risen, 2010; Izuma & Murayama, 2013), these findings raise the question when these preferences emerge, how these relate to the earlier findings by Silver et al. (2020), and what marks the emergence of cognitive dissonance?

In the present study, we therefore sought to test when *blind* choices start inducing children's preferences. We reasoned that the age of emergence of blind choice-induced preferences and their relation to developments in other cognitive domains, such as the self-concept, would inform the mechanisms underlying their emergence. The gap in the previous literature suggests that this development might occur between infancy and preschool-age. We had hypothesized that cognitive dissonance would rely on a basic concept of the self. We therefore predicted that blind choice-induced preferences would emerge after the second year of life, where infants undergo important developments of their self-concept, as marked by mirror self-recognition and the use of verbal self-reference (Amsterdam, 1972; Rochat, 2010; Lewis & Ramsay, 2004). Moreover, we hypothesized that their emergence would in fact be related to these markers of self-concept development.

We tested these hypotheses in a study where we presented 16- to 36-months-old children with the blind choice between two objects, and then offered them a second choice between the previously discarded and a third neutral object. Cognitive dissonance theory predicts that children would avoid the previously discarded object since they should have devalued it as a consequence of the previous choice. In a second condition controlling for other motives such as novelty- or side-preferences, children were offered a choice between the previously chosen and a third neutral object. Here, cognitive dissonance theory predicts that children prefer the previously chosen object since this should have increased in value due to the previous choice. We wanted to investigate at what age these blind choice-induced preferences emerge, and whether their emergence is related to the development of children's self-concept. To this aim, children additionally took part in a mirror self-recognition test (Amsterdam, 1972; Kampis, Grosse Wiesmann et al., preprint), a self-other mapping task (Kampis, Grosse Wiesmann et al., preprint), and their use of verbal self-reference (i.e., their own name and first-person pronouns) was assessed with a parent questionnaire. We hypothesized that choice-induced preference changes might correlate with these measures of self-concept development.

Methods

The cognitive dissonance task was preregistered at [https://aspredicted.org/blind.php?x=n7s8c6] and the relation with measures of self-concept at [https://aspredicted.org/blind.php?x=n9kq9g]. In addition, a second, older age group (26-36 months) was included to follow up on the developmental trajectory, after we found evidence against blind-choice induced preferences in the younger, preregistered sample of children.

Participants

The present study reports data of N=200 Danish speaking children between 16 and 36 months of age (median age: 24 months, quartiles: 20-29 months; 106 female). Data collection was stopped at N=123 children in the younger age group (16;0-26;0 months), after the planned point of analysis at N=120 had been reached (the results for the first N=120 are highly similar to those including the additional 3 participants acquired, see Supplementary Information (SI) Table S1). Because we found evidence against blind-choice induced preferences in this younger age group, we followed up on the developmental trajectory of cognitive dissonance with a second age group aged 26;0 to 37;0 months with a Bayesian sequential testing scheme until a Bayes factor of 4 or 1/4 would be reached with a minimum number of participants of N=70 to control for false positives and negatives (Mani et al., 2021; Stefan et al., 2019; details see SI section 1.2 Bayesian sequential analysis). An additional N=7 children had been tested when the data was analyzed, yielding a total of N=77 children aged 26-36 months (results for the first 70 participants are highly similar, see SI Table S2). An additional N=16 children in the younger age group and N=1 child in the older group only contributed data to one of the two experimental conditions, because of camera error (2), abortion of the task before the end of the second test trial (11), no clear choice (2, e.g. repeatedly touching the middle of the stocking or both objects simultaneously), parental interference (1), or strong fussiness (1) on the second test trials, and were thus only included in analyses of the condition that they contributed to. An additional N=10 younger children and N=1 older child had to be excluded because of a health condition of the child (1), abortion of the task before completing any test trials (6), error of the experimenter (1), no clear choice in both test trials (1), and unwillingness to let go of one of the familiarization toys (2). Reasons for exclusion were attributed according to the listed order in case two or more of these reasons applied.

Children were recruited via digital mail through the citizen registration office and tested in the lab (N = 156) or recruited and tested on-site at a science museum (N = 44). Of the children with complete data sets of both experimental conditions, 85 also contributed data to a mirror self-recognition task, 115 children to a parent questionnaire on verbal self-reference, and 81 children participated in a study on spontaneous self-other mapping behavior (Kampis, Grosse Wiesmann et al., preprint). The study was approved by The Faculty of Social Sciences' Research Ethics Committee of the University of Copenhagen, and parents signed an informed consent prior to participation.

Procedure

The experimental procedure was inspired by Egan et al. (2010). Children were seated on their parent's lap at a table opposite of the experimenter, who gave them a box and told them they were going to play a fun game where they could choose some toys to put in their box and to play with later. To familiarize children with making blind choices, children first received between two and four familiarization trials until they showed a clear choice. They then received two test trials, one of each experimental condition (described below), in randomized order across participants.

In the familiarization trials, children were presented with a unicolored stocking whose outline revealed two objects (see Fig. 1). The experimenter then took these objects (e.g., a toy apple and banana) out of the stocking, showed them to the child, and stuffed them back into a new stocking while saying "I will put them in here and you can choose one of them". The stocking was then passed over to the child keeping the outline of the two objects at approx. 20 cm distance and the child was told "You can choose one, which one do you want?" In case the child did not make a clear choice (e.g., touched both objects at once or did not choose at all), the experimenter pulled back the stockings, emphasized that the child could only choose one and offered them to choose again as before. Children were presented with between two and four object pairs in the familiarization until they had made at least one clear choice.

Figure 1. Materials for the cognitive dissonance task. In each of the experimental conditions children were presented with a different set of three stuffed animals of identical shape **(1A)**. Two of these toys were then hidden in one stocking and the third toy in another stocking **(1B)**. Children were now given the blind choice between the first two toys. After this initial choice, they were given a second choice between the third object, which they had not been able to choose from before, and the previously discarded object (condition: unchosen vs. neutral), or in the control condition, the previously chosen object (condition: chosen vs. neutral).

For the test trials, parents were asked to close their eyes. Children were now presented with a stocking showing the identical outlines of three stuffed animals (see Fig. 1a). The animals were taken out of the stocking, shown to the child, and the experimenter announced that she would hide them in two new stockings with different patterns, which she then did behind an occluder. The child was then shown the outline of two of the animals in one stocking and the third animal in the other stocking (Fig. 1b). The children thus knew the pool of objects they were choosing from but had no way to know which was which. The stocking containing the third animal was put aside, and children were given the choice between the other two, exactly as in the familiarization trials. After this initial choice that was intended to induce a preference for the chosen and a devaluation of the unchosen toy, children obtained a second choice to test whether they had developed an according preference. There were two experimental conditions, conducted in randomized order within-subjects. In the *unchosen-versus-neutral* condition, children received the toy they had chosen, and were then given a second choice between the toy they had previously discarded (the *unchosen toy*) and the third neutral object that had been put aside before, while both objects remained hidden in their stocking. Cognitive dissonance theory predicts that children would avoid the unchosen toy and prefer the neutral toy as the unchosen toy should have been devalued by the previous choice. In the control condition – the *chosen-versus-neutral* condition – after children's initial choice, the toy they had chosen remained on the table hidden in the stocking, and instead, the unchosen toy was taken out and discarded into a box on the experimenter's side. The children were then given the choice between the previously chosen toy and the third neutral one. Here, cognitive dissonance theory predicts that children should stick to their choice and prefer the previously chosen over the third neutral object as their previous choice should have increased its value. The chosen-versus-neutral condition served as a control condition to ensure that a preference observed for the third neutral object in the unchosen-versus-neutral condition did not result from a novelty preference. Overall, the two experimental conditions made opposite predictions and were constructed to control for any alternative explanations, such as a novelty preference for the third toy or an ownership preference for the chosen one.

Two different sets of toys and stockings were used for the two conditions, counterbalanced across participants (Fig. 1). The order of the conditions was also counterbalanced across participants, and the side of the toys in the second choice was counterbalanced compared to the initial choice to ensure that individual side biases would not explain any consistent preference.

Data coding and dependent variables

Children's first touch or point to one of the two object outlines was coded as their choice. For correlational analyses, a *cognitive dissonance score* was formed, defined as 1 if children chose in line with cognitive dissonance predictions in both experimental conditions (i.e., chose the neutral over the unchosen, but the chosen over the neutral), as 0 if children chose in line with cognitive dissonance predictions on one of the two experimental conditions, and as -1 if children took the opposite choices of those predicted by cognitive dissonance theory (i.e., chose the unchosen over the neutral, but the neutral over the chosen). 25% of the data (N=50) were coded by two independent coders, who agreed in 96% of the cases. The two cases of disagreement were resolved by a third coder.

As an additional exploratory measure, we analyzed children's hesitation when taking a choice between the previous and the neutral toy. The results are reported in the supplementary material (section 2. Hesitation).

Measures of self-concept development

Mirror self-recognition task. Of the Children aged between 16 and 26 months N=85 also successfully took part in the classic mirror self-recognition test (Amsterdam, 1972; procedure as in Kampis, Grosse Wiesmann et al., preprint), and an additional N=14 had to be excluded (see details below). The task included four phases: exposure to the mirror before applying a mark on the child's face (phase 1); application of a color mark on the child's face with occluded mirror (phase 2); second exposure to the mirror with the child having a mark on their face (phase 3); finally, the experimenter pointed to the child's reflection in the mirror and asked "Who is that?" (phase 4). Children were classified as passers (1) if they touched the mark in phase 3 or 4 after seeing themselves in the mirror or if they produced first-person pronouns or their own name in response to their mirror image, and classified as non-passers (0) if they did not show any of these behaviors. No child touched the mark in phase 2 before seeing themselves in the mirror. Children who did not look at their mirror image for at least 3 fixations or at least 10 seconds in phase 3 or 4 (N=1) were excluded. In addition, 2 children were excluded for not coming to the mirror at all, 1 for aborting before phase 3, for 3 children the video footage was insufficient to code the task, 1 for parental interference, and 6 were excluded because their mark was not well visible. 20 % of the children were coded by two independent coders who agreed in 95 % of the cases. The only case of disagreement was resolved by a third coder.

Parent questionnaire. Parents were asked to fill out a questionnaire on children's production of verbal self-reference, that is, first-person pronouns or their own name (for details see Kampis, Grosse Wiesmann et al., preprint). Children were given a score of 0 if they produced no verbal self-reference, 1 if they produced only their own name, and 2 if they produced first-person pronouns.

Self-other mapping task. Finally, an overlapping sample of children (N=81) participated in a study on self-other mapping (Kampis, Grosse Wiesmann et al., preprint; preregistered at https://osf.io/7ut9k?view_only=a9b5146f960f456bb95f791edce614a1). In this study, children saw their parent with a sticker on their face (on their cheek or forehead, depending on condition). They were then offered a sticker themselves, and it was coded whether they spontaneously placed the sticker on the matching location on their own face, which was thought to reflect an understanding of the mapping between others' face and their own. To test our hypothesis about the relation of cognitive dissonance with self-concept development, in a more exploratory fashion, we therefore additionally investigated the correlation of children's cognitive dissonance score and their matching sticker placement as a proxy of their understanding of themselves in relation to others.

Frequentist analyses and Bayesian equivalents

To be able to estimate evidence both in favor of and against our hypotheses, in addition to the preregistered frequentist statistical analyses, we computed Bayesian equivalents of these statistical tests. Frequentist statistics were computed with IBM SPSS Statistics version 27 and Bayesian equivalents with R using R version 4.0.2, R Studio, the R package BayesFactor, and scripts by van Doorn et al. (2020). Subsequently, we report the Bayes factor for the alternative hypothesis BF_{10}, which indicates how much more likely the alternative hypothesis is than the null-hypothesis. $1 < BF_{10} < 3$ is considered to show anecdotal evidence, $3 < BF_{10} < 10$ moderate evidence, and $BF_{10} > 10$ strong evidence for the alternative hypothesis. Values smaller than 1, in contrast, show evidence for the null hypothesis, where $1/3 < BF_{10} < 1$ is considered anecdotal evidence, $1/10 < BF_{10} < 1/3$ moderate evidence, and $BF_{10} < 1/10$ strong evidence for the null hypothesis.

Most statistical tests we used have direct Bayesian equivalents in R. The McNemar test corresponds to a bi-sided binomial test between the off-diagonal elements of the cross-table (Conover, 1999). Thus, for the Bayesian equivalent of the McNemar test, a Bayesian Binomial test between the off-diagonal elements of the cross-table was computed.

Results

Cognitive Dissonance Task

The cognitive dissonance task was first assessed in children in the preregistered age group of 16;0 to 26;0 months. To test whether children showed blind-choice induced preferences, we tested children's differential preferences in the two experimental conditions with a McNemar test. 16- to 25-months-olds showed moderate evidence against a differential preference in the unchosen-versus-neutral and the chosen-versus-neutral condition (see Table 1; McNemar's Chi-squared(N=123) = .022; p = 0.883; Bayesian Binomial test between off-diagonal elements $BF_{10} = 0.19$). To follow-up on the developmental trajectory of blind choice-induced preferences, a second group of children aged 26- to 36-months were tested, within a Bayesian sequential testing framework (see SI section 1.2). In contrast to the younger children, the older children showed moderate evidence for differential preferences for the neutral over the unchosen, but the chosen over the neutral object in line with cognitive dissonance predictions (see Table 2; McNemar's Chi-squared(N=77) = 6.618; p = .010; Bayesian Binomial test between off-diagonal elements $BF_{10} = 9.36$).

Table 1. Distribution of choices in children aged 16-25 months: No differential preferences in the unchosen-versus-neutral and the chosen-versus-neutral conditions (McNemar: $p = .883$; Bayesian Binomial test between off-diagonal elements: $BF_{10} = 0.19$).

	Previous (chosen)	Neutral
Previous (unchosen)	31	22
Neutral	24	46

Table 2. Distribution of choices in children aged 26-36 months: Children showed differential preferences for the neutral over the unchosen, but the chosen over the neutral object (McNemar: $p = .010$; Bayesian Binomial test between off-diagonal elements: $BF_{10} = 9.36$).

	Previous (chosen)	Neutral
Previous (unchosen)	22	9
Neutral	25	21

16- to 25-months-olds showed no systematic preference in either of the two conditions: 58% of the children (78 out of 134) preferred the neutral over the previously unchosen object (binomial test: $p = .069$), and 54% (69 out of 128) preferred the neutral over the previously chosen object (binomial test: $p = .426$). The 26- to 36-months-old children, in contrast, tended to prefer the neutral over the previously unchosen object (60%, i.e. 47 out of 78, binomial test: $p = .089$), but the previously chosen over the neutral object in the control condition (61%, i.e. 47 out of 77, binomial test: $p = .068$), as predicted by cognitive dissonance.

To investigate the development of blind choice-induced preferences over the whole age range, we computed the correlation of the cognitive dissonance score with age, yielding strong evidence for an increase in choice-induced preferences with age (Spearman roh(200) = .241; $p = .00058$; Bayesian equivalent $BF_{10} = 12.53$). Children’s tendency to adapt their preferences to their previous blind choice thus increased between 16 and 36 months (see Figure 2).

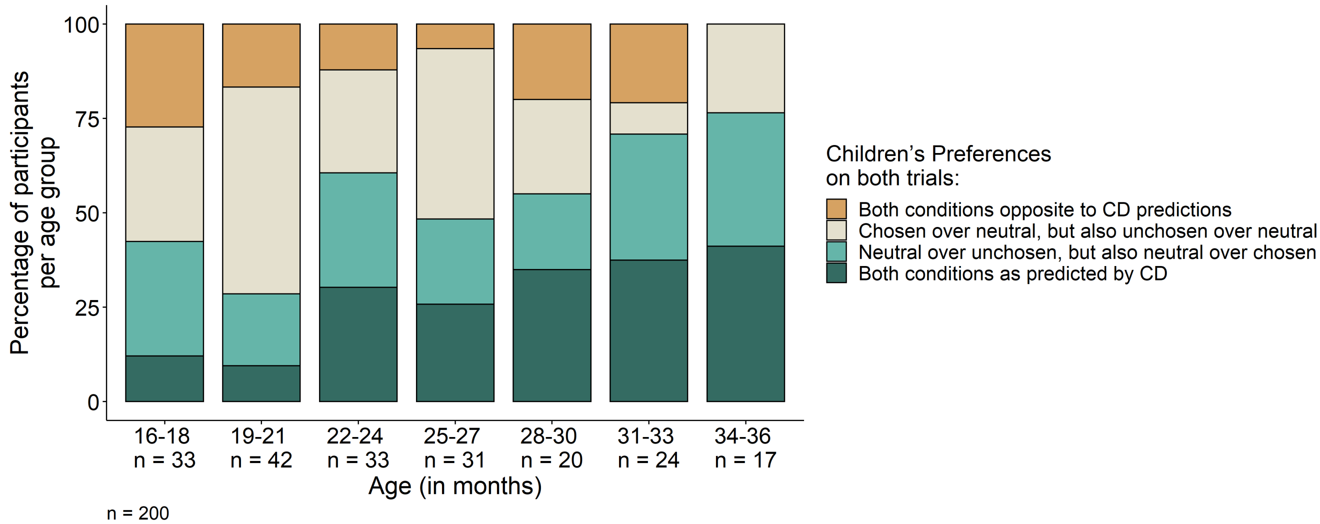

Figure 2. Children's choice-induced preferences as predicted by cognitive dissonance theory (CD) increased with age (roh(200) = .241; p = .00058; BF_{10} = 12.53).

Finally, to check for any effects of trial order, we computed a Mann-Whitney U Test comparing the cognitive dissonance score in children who had received the unchosen-versus-neutral condition first with those who received the other condition first. This yielded moderate evidence against an effect of trial order (U(N=200) = 5268; p = .441; Bayesian equivalent: BF_{10} = .20).

Relation with measures of self-concept development

Mirror self-recognition. Contrary to our hypotheses, a Mann-Whitney U test revealed no difference in cognitive dissonance score between children who passed the mirror-self recognition task (Mean rank = 39.69) and children who did not pass (Mean rank = 44.09; Mann-Whitney U(N=85) = 741.50; p = .394), and the Bayesian equivalent revealed moderate evidence against such a difference (BF_{10} = .30). This lack of a relation between mirror self-recognition and blind choice-induced preferences in children aged 16 to 26 months was also confirmed by evidence against a correlation between mirror self-recognition and the cognitive dissonance score (see Table 3). In line with these findings, neither mirror self-recognition passers nor non-passers showed the predicted differential choosing behavior in the two conditions (recognizers: McNemar's Chi-squared(N=64) = 0.0; p = 1.00; Bayesian Binomial test between off-diagonal elements BF_{10} = .26; non-recognizers: McNemar's Chi-squared(N=21) = 0.8; p = .375; Bayesian Binomial test between off-diagonal elements BF_{10} = 1.07).

Other measures of self-concept development. Similarly, children's use of their own name and/or first-person pronouns (verbal self-reference score) was not related to their cognitive dissonance score, nor was their spontaneous self-other mapping behavior (see Table 3).

Table 3. Spearman correlation between cognitive dissonance score and different measures of self-concept development in infants aged 16-26 months: mirror self-recognition, verbal self-reference, and self-other mapping. There was moderate evidence against a relation between choice-induced preferences and measures of self-concept development.

	Cognitive dissonance score			
	Spearman roh	N	p-value	BF_{10}
Mirror self-recognition	.093	85	.397	.235
Verbal self-reference	.026	115	.783	.139
Self-other mapping	-.020	81	.863	.182

Discussion

In the present study, we found that toddlers develop blind choice-induced preferences in accord with cognitive dissonance from around 2 years. More specifically, we found strong evidence for an increase of choice-induced preferences between 16 and 36 months. 26- to 36-months-olds preferred a neutral object, which they had not been able to choose before, over an object that they had previously discarded in a blind choice, but preferred a previously chosen object over the neutral object in the control condition, in line with cognitive dissonance predictions. Infants aged 16- to 25-months, in contrast, showed evidence against such blind choice-induced preferences.

Similar blind choice-induced preferences have been found in adults (e.g., Enisman et al. 2021) and older children (Egan et al. 2010). They are considered a critical test of cognitive dissonance theory as the fact that these preferences arise even when participants are choosing blindly ensures that their choice and later preference could not have resulted from any actual initial preference for the chosen object (Chen & Risen, 2010; Izuma & Murayama, 2013). A recent study by Silver et al. (2020) found that young infants aged 10- to 20-months already showed choice-related preferences, when their choices had *not* been blind but they knew the options they were choosing from. When their choices were blind, however, infants did not show any such preferences, in line with our findings in the younger age group (16-25 months). That is, while infants already show some form of choice-*related* preferences, it is not before the age of 2 years that children's blind choices modulate their preferences when they do not know the identity of the object they are choosing. Together, these findings raise the question of what cognitive mechanisms underlie the emergence of *blind* choice-induced preferences around 2 years of age.

We had hypothesized that the development of toddlers' self-concept might be crucial for the emergence of cognitive dissonance as we reasoned that perceiving a conflict between one's actions and values should require at least a basic concept of the self to which these actions and values could be attributed. Alongside the main task, we therefore also administered measures of self-concept development for children in their second year of life (i.e., mirror self-recognition, use of verbal self-reference, and self-other mapping) and hypothesized a relationship between these measures and blind choice-induced preferences. However, we found evidence against a relation between these self-concept measures and blind choice-induced preferences. How can we interpret these findings? First, this indicates that the kind of self-concept tapped by traditional measures in the second year of life is not sufficient for the observed emergence of blind-choice induced preferences around 2 years of age. It is still possible that self-awareness at this age is necessary for cognitive dissonance to manifest, but that other factors are also important. It is also possible that the emergence of blind choice-induced preferences is related to other, later-developing aspects of the self-concept. For example, a temporally extended self-concept or the development of self-related memory might be important for linking one's previous choices to the later preferences. Between 24 and 30 months of age, children also undergo important developments in their understanding of ownership (Blake & Harris, 2011), which may have influenced their understanding of the chosen object as the one they now own. While infants in their second year of life mainly seem to understand ownership as visual person-object associations (Blake & Harris, 2011), by 30 months of age children can update their representation of the ownership of an object when this object is not visible to them (Blake, Ganea, & Harris, 2012, Blake & Harris, 2011). Children's increasing understanding of their ownership over the unseen chosen object in our blind choice paradigm might have contributed to a later preference for the chosen object. In our study, however, children also avoided the previously unchosen object over a third neutral object – both objects that the children did not own. It is therefore unlikely that the observed choice-induced preferences were a consequence of children's feeling of ownership.

Another possibility is that cognitive dissonance phenomena may be unrelated to the self-concept. Several theories have argued how choice-induced preferences may arise without the need of a self-concept. It has been suggested, for example, that individuals may learn through experience that inconsistent actions and preferences may have aversive consequences and thus learn to avoid them by adjusting their preferences (e.g., Cooper, 2007). Building on such theories, choice-induced preferences have been simulated by neural networks based on models that do not require any concept of the self (Shultz & Lepper, 1996; van Overwalle & Jordens, 2002). Experience-based accounts also predict that cognitive dissonance phenomena would emerge in the course of early childhood as children gather more experience with making choices and with negative action outcomes (Cooper, 2007), suggesting that the emergence of cognitive dissonance may be independent of developments of the self-concept.

What else could have caused the emergence of blind choice-induced preferences specifically around 2 years of age? A closer look at the findings by Silver and colleagues (2020) on choice-related preferences in infants aged 10 to 20 months in relation to our findings highlights the special role of *blind* compared to informed choices. In line with our findings, Silver et al. (2020) found that young infants aged 10- to 20-months did not show choice-induced preferences when they had chosen between two objects blindly. When infants knew the identity of the objects they were choosing from, however, they showed choice-related preferences. One explanation for these findings could be that infants' preferences had not been induced by their choices, but instead both their choice and later preference reflected an actual initial preference for the other toys over the unchosen toy (see e.g., Chen & Risen, 2010; Egan et al., 2010; Izuma & Murayama, 2013). In a follow-up experiment, however, the authors found that infants' preferences were also influenced by their previous choices when they were tricked into believing they had chosen an object, showing that this later preference could not have resulted from an actual initial preference for the object they appeared to have chosen. Together with our findings of the emergence of blind-choice induced preferences around 2 years of age, these findings raise the question of what underlies this developmental change from *known* choice-induced preferences in infants to *blind* choice-induced preferences in 2-year-olds. If young infants' preferences are indeed already influenced by cognitive dissonance at 10 to 20 months, why then would they not show these choice-induced preferences when their choices were blind, as adults and older children do (Enisman et al., 2021; Egan et al. 2010)?

An intriguing possibility is that toddlers' increasingly abstract representational abilities might contribute to their understanding of blind choices. In order to update the value of a hidden object whose identity children do not know, children need to hold a representation of this object that they can update, which is independent of the object's identity or appearance. Early on in life, infants' representations are thought to be tied to perceptual input (e.g., Leslie, 1987; Perner, 1991). In the course of the second year of life, children have been argued to become able to form representations of the world that are detached from direct perception (e.g., Leslie, 1987; Perner, 1991; Suddendorf & Whiten, 2001). This would allow children to manipulate a representation of an object in their mind (for example, update its value) without informing this representation by perception. A number of studies have shown that, between 22 and 30 months, children start being able to update their representation of objects that they don't see (e.g. Ganea et al., 2007; Ganea & Harris, 2010; Blake, Ganea, & Harris, 2012). Toddlers in their third year of life do not only start updating the ownership of absent objects based on verbal information (Blake, Ganea, & Harris, 2012), but they also update their representation of the appearance of objects, while these are absent (e.g. Ganea et al., 2007) and of the location of unseen objects (Ganea & Harris, 2010, 2013; Collier-Baker & Suddendorf, 2006). Thus, while younger infants' preferences may already be guided by cognitive dissonance in Silver et al. (2020), it might be that, at this young age, infants need to see the object they chose or did not choose in order to be able to update their value. It may only be around 2 years of age that children become able to update their representation of a *blindly* chosen object, which they cannot see and whose identity they do not know at the moment of choice.

Many questions remain for future research. One question concerns the relation of cognitive dissonance with self-concept. We found evidence against a relation between blind choice-induced preferences and measures of self-concept development in the second year of life. It is possible, however, that toddlers' blind choice-induced preferences still require the presence of self-awareness but that other factors, like the ability to deal with absent referents, are also necessary. Thus, it could be tested whether the preferences induced by non-blind, tricked choices in 10- to 20-months-old infants (Silver et al., 2020) are related to early markers of self-concept development in the second year of life, as tested in the current study. It is also possible that blind choice-induced preferences are related to other, later-developing aspects of the self-concept, such as temporally extended self-concept, self-related memory, or the understanding of ownership. At what age infants or toddlers start perceiving cognitive dissonance also remains an open question. Do preverbal infants' preferences in Silver et al. (2020) indeed already reflect cognitive dissonance or do the blind choice-induced preferences from 2 years of age in the current study mark the emergence of cognitive dissonance? Two approaches could be taken to clarify this question. First, a control condition in Silver et al.'s tricked choice experiment would help ensuring that infants' preferences in Silver et al. (2020) were indeed induced by what they believe to have been their choice and not by other aspects of the trick situation (e.g., by avoiding the object they had been tricked on and therefore going for the neutral object, exactly as observed in Silver et al., 2020). A control condition in which children are not predicted to prefer the neutral object, similar to the one employed in our study or previous studies (Egan et al., 2008, 2010) could clarify whether infants' preferences in Silver et al. (2010) were indeed *induced* by their choice. If this confirmed that infants' choices indeed induced preferences, as long as these choices are not blind, the factors mediating the transition from *informed* choice-induced preferences to *blind* choice-induced preferences require further investigation. In particular, it could be tested whether toddlers' increasingly abstract representational abilities (e.g., Leslie 1987; Perner 1991) and their emerging ability to update their representations of unseen objects (e.g., Ganea et al., 2007, 2010, 2013) predicts the observed emergence of blind choice-induced preferences around 2 years of age.

Conclusions. What can we conclude from the present research? We have demonstrated that blind choice-induced preferences, considered as a critical test of cognitive dissonance theory, emerge around 2 years of age. We have shown that the emergence of these preferences is not related to early markers of self-concept development. Later-developing aspects of the self-concept may foster the development of cognitive dissonance and the emergence of blind choice-induced preferences. Another possibility is that toddlers' developing abilities to represent their environment independently of perceptual input allows them to update the value of objects whose identity they do not know and thus paves the way for *blind* choice-induced preferences.

Acknowlegments

The authors would like to thank all participating families, as well as Nikoline Husen for her help with testing participants. The present work was supported by an ERC Consolidator Grant DEVOMIND 726114 to VS and a Marie Słodowska-Curie Fellowship 799734 ToMSelfLink to CGW.

The authors declare no conflict of interest.

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