Article

Validation of the Intention Attribution Test for Children (IAC)

Assessment
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Abstract

The Intention Attribution Test for Children (IAC) was created to assess hostile attribution bias in preschool- and early school-aged children. It comprises 16 cartoon strips presenting situations in which one character (either a child or an adult) causes harm to another, either intentionally, accidentally (nonintentional), or without his or her intention being clear (ambiguous). Its validity was tested on 233 children aged 4 to 12 years. Exploratory factor analysis and item response theory models demonstrated support for a single factor of hostile attribution bias for the ambiguous and nonintentional items. Analyses revealed, however, that the intentional items did not contribute to this same overall construct of hostile intention attribution bias. Correlations with the Social Perception Test and with sociometry suggest good validity of the IAC. The IAC may be a useful instrument for research and in the context of therapeutic intervention addressing socially inappropriate behavior in childhood.

Keywords

assessment, social cognition, hostile attribution bias, development, children

The present study presents a new measure for assessing hostile attribution bias among preschool and school-age children, and tests its validity. The instrument is designed to assist in identification of distortions or deficits in the processing of social information that increases the risk of socially inappropriate behaviors. Numerous studies support Crick and Dodge's (1994) postulate that the attribution of intention is an early stage in information processing that orients behavior in new social situations. It has been shown, for instance, that aggressive children more frequently attribute hostile intentions than do their nonaggressive peers (Fitzgerald & Asher, 1987; Dodge et al., 2015; Dodge & Frame, 1982; Dodge & Tomlin, 1987; Guerra & Slaby, 1989; Quiggle, Garber, Panak, & Dodge, 1992; Waas, 1988) and, conversely, that children whose behavior is prosocial present a nonhostile intention attribution bias (Nelson & Crick, 1999).

Intention Attribution Bias Tasks

The processing of social information evolves with age and cognitive development, in particular, executive functioning (Carlson, Claxton, & Moses, 2015; Crick & Dodge, 1994; Wolfe, Vannatta, Nelin, & Yeates, 2015). The ability to envisage the social world as being made up of people whose actions reflect intentions appears early on in development (Woodward, Sommerville, Gerson, Henderson, & Buresh, 2009). The ability to attribute intentions to other people in situations of provocation develops between the ages of 2 and 3 years (Dodge, 2006; Flavell, 1999). The links between hostile attribution bias and social behavior are thought to develop progressively between preschool and school age. Runions and Keating (2007) report that the link between hostile attributional bias and aggressive behaviors can be observed as early as preschool age, but that it becomes much more marked from the ages of 6 or 7 years. Thus, to evaluate the development of such biases and their possible links with maladaptive behavior, a test adapted to both preschool and school-age children is needed.

Limitations of Existing Instruments for Assessing Attribution of Intention

Few extant tools enable the assessment of hostile attribution bias for both preschool- and school-aged children. Methodological pitfalls may explain why existing tests are

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specific to an age group, as the level of cognitive development of preschool-aged children requires that tasks designed for school-aged children be adapted. Among existing intention attribution tasks, the Social Perception Test (SPT; Suess, Grossmann, & Sroufe, 1992) is designed for preschool children. This instrument comprises six cartoon strips, each presenting two or three panels showing typical conflict situations between children. In two situations, hostile intent is explicitly represented (e.g., a child intentionally punches another one who is sitting on a swing). In two other situations, the intention is explicitly nonhostile (e.g., a child is upset after making another one fall while pushing him on the swing) and, in the last two situations, the intention is ambiguous (a child is playing ball and the ball lands on the tower that another child is building). The material for this task, at once recreational and relatively independent of working memory, appears particularly well suited to assess the attribution of intention in preschool children. However, the fact that there are only two ambiguous situations in the test may restrict its scope for measuring the hostile attribution bias. In addition, for the nonambiguous pictures, each scene is used twice with a different intention. In and of itself, this may bias attributions by encouraging the same type of response to the two pictures.

Moreover, the SPT drawings do not always show clearly whether the provocateurs are adults or children. Yet adult–child and child–child interaction are interdependent processes, both central to early socialization. However, they are typically evaluated separately (Parke & Ladd, 1992/2016), a strategy that may undermine the comprehensive understanding of hostile attribution bias. Finally, although the SPT has been used in experimental protocols, to our knowledge, there has not been a validation study.

Dodge and Price (1994) developed the Social Information Processing Interview (SIPI). This measure assesses the different stages in social information processing defined by Crick and Dodge (1994): the encoding of clues, the interpretation of the situation, the choice of a behavioral response, and an evaluation of the behavioral response chosen. The SIPI was developed for school-age children (6-10 years). It comprises different films, staging problem situations between children or between children and adults: situations in which the child is rejected by a peer group, situations where a child is challenged by a peer, and situations where an adult forces the child to do something disagreeable, like tidying a messy room. In each of these situations, the intention is either hostile, nonhostile, or ambiguous. The children are invited to answer several questions pertaining to the hypothesized information processing stages (i.e., encoding, interpretation, response generation, and response evaluation), and different scores are computed after combining the different stories. The internal consistency of the SIPI is low for some scales, with a median alpha of .63. A preschool version of the SIPI, the SIPI-P (Ziv, 2007; Ziv & Sorongon, 2011), with good psychometric properties (Cronbach's $\alpha = .76$ for HIA scores), exists for children aged 4 to 5 years. The SIPI and the SIPI-P differ with respect to item format: open-ended for the SIPI and closed-ended for the SIPI-P. This discontinuity introduces a confound, as it becomes unclear whether response discrepancies are due to differential cognitive capacity or disparate task demands. The characters also differ in the two instruments, with human children in the SIPI and bear characters in the SIPI-P. Finally, the SIPI-P is much shorter than the SIPI. These differences introduce noise into the comparison between the SIPI and the SIPI-P and thus preclude comparisons between preschool and school-age children.

For the study of the development of hostile attribution bias from preschool to school age to become feasible, a test suited to both these age groups, composed of a large diversity of situations, including interactions between children and between an adult and a child, seem necessary. The Intention Attribution Test for Children (IAC) was thus developed for children aged 4 to 12 years and its validity was tested (see Table 1 for description and Figure 1 for examples). The test comprises 16 colored cartoon strips presenting 16 situations in which one character causes harm to the other (see supplemental material available online: www.researchgate.net/publication/331048821_Intention_Attribution_Test_for_Children_IAC), either intentionally (intentional), accidentally (nonintentional), or without his or her intention being clear (ambiguous). Each strip is a staged scene that is unique. To be accessible to preschool children, cartoon strips are short (each including 2 or 3 colored panels) with no text to be read, along the lines of the SPT (Suess et al., 1992). The choice of these short cartoon strips restricts the cognitive load for children by enabling continuous access to all the information. This reduces possible bias linked to limitations in attention span and working memory.

To reflect the diversity of situations children can be faced with in everyday life, the character causing harm to the other is a child for half of the strips of each type (intentional, nonintentional, and ambiguous), an adult for the other half. The victim is a child in all the strips. In this test, the child is specifically asked to identify with the victim ("imagine you are that child") and this identification is reinforced implicitly by the development of a set of strips for girls and a set for boys, administered according to participant gender. This strategy of asking the child to identify with the victim is based on results obtained by Dodge and Frame (1982), who reported that social cognitive biases among aggressive children were evidenced when participants were the target of provocation, but not when they observed a provocation between peers in which they were not involved. Based on these observations, it can be assumed that attributional biases appear more clearly when participants identify with the victim.

Table 1. Description of the 16 Cartoon Strips.

No.	Type	Description of the cartoon strips
1	Intentional	A child deliberately destroys the snowman of another child.
2	Ambiguous	A child kicks a ball which hits another child's head.
3	Nonintentional	An adult carries a child on his shoulders and the child's head hits a tree branch. The adult comforts the child.
4	Ambiguous	An adult goes through a puddle on his bike and splashes the toy of a child standing nearby.
5	Intentional	An adult shouts at a child.
6	Ambiguous	An adult goes to the supermarket, while a child remains in the car and cries.
7	Nonintentional	A child upsets a pot of paint on the drawing of another child and shows he is sorry.
8	Ambiguous	A child falls onto the tower made of cubes of another child.
9	Intentional	A child pushes another and appears pleased with what he has done.
10	Ambiguous	A child spills a jug of water on another child's plate.
11	Nonintentional	An adult distributes candies to children and is sorry when she sees that there are no more sweets for the last child.
12	Ambiguous	A child climbs a tree using a ladder. The child is in the tree and picks apples when a man comes and takes the ladder.
13	Intentional	Two children are playing. One of them breaks a vase. An adult sees which child breaks the vase but scolds the other child.
14	Ambiguous	An adult waters the garden and as he raises the hose, some water drops on the sandcastle a child hidden by the shrubs is making.
15	Nonintentional	A child treads by accident the glasses of another child.
16	Ambiguous	A child rides a bike downhill and bumps into another child.

Method

Procedure

The project was presented to principals and teachers of seven different schools. If the principals agreed to having their school participate, written information on the study was given to the pupils' parents. Approximately half the parents gave their consent for the study and signed authorizations; the other half either refused or did not answer. All the children whose parents agreed to participate in the study consented. They came from 17 different classes, ranging from the second year of preschool to sixth grade. The tests were administered individually by graduate students in a quiet room in the children's schools. The study was conducted in accordance with the terms of the Helsinki World Medical Association Declaration on Ethical Principles for Medical Research involving Human Subjects.

Participants

The study sample included 233 children (119 girls and 114 boys), aged 4 years 1 month to 12 years 11 months ($M = 7$ year 10 months, $SD = 2$ years 8 months). Seven graduate students administered the IAC as well as the Wechsler intelligence scales at the children's school. Sociometry was collected for 195 children and the SPT was administered to 137 children. Two school-aged children with an intellectual disability as identified using the Wechsler intelligence scale for children–IV (abridged IQ < 2, *SD* below the *M* of 100; Wechsler, 2003), and three preschool-aged children at risk of intellectual disability (as identified using two tests of the Wechsler Preschool and Primary Scale of Intelligence–III assessing the level of reasoning; Wechsler, 2002) were excluded from the study.

Instruments

Intention Attribution Test for Children. The order of administration is predetermined, alternating ambiguous and nonambiguous strips, and alternating nonambiguous strips that represent intentional harm and others that do not. Thus, the ambiguous strips are preceded by a strip showing intentional harm or by a strip showing unintentional harm, so as to control the influence of nonambiguous strips. The order of administration also involves alternating strips with child and adult provocateurs. Task administration takes 15 to 20 minutes.

Instructions. The instructions given to the respondent are as follows: "Look at these pictures. Imagine that you are this child (pointing to the character who is the victim in the different pictures). Can you tell me what is happening in these pictures?" If the child's spontaneous response makes it possible to determine whether he or she perceived the action as intentional or nonintentional, no further question is asked and his or her answer is scored. If, on the other hand, his or her reply does not enable a conclusion, the following question is asked: "Did this child

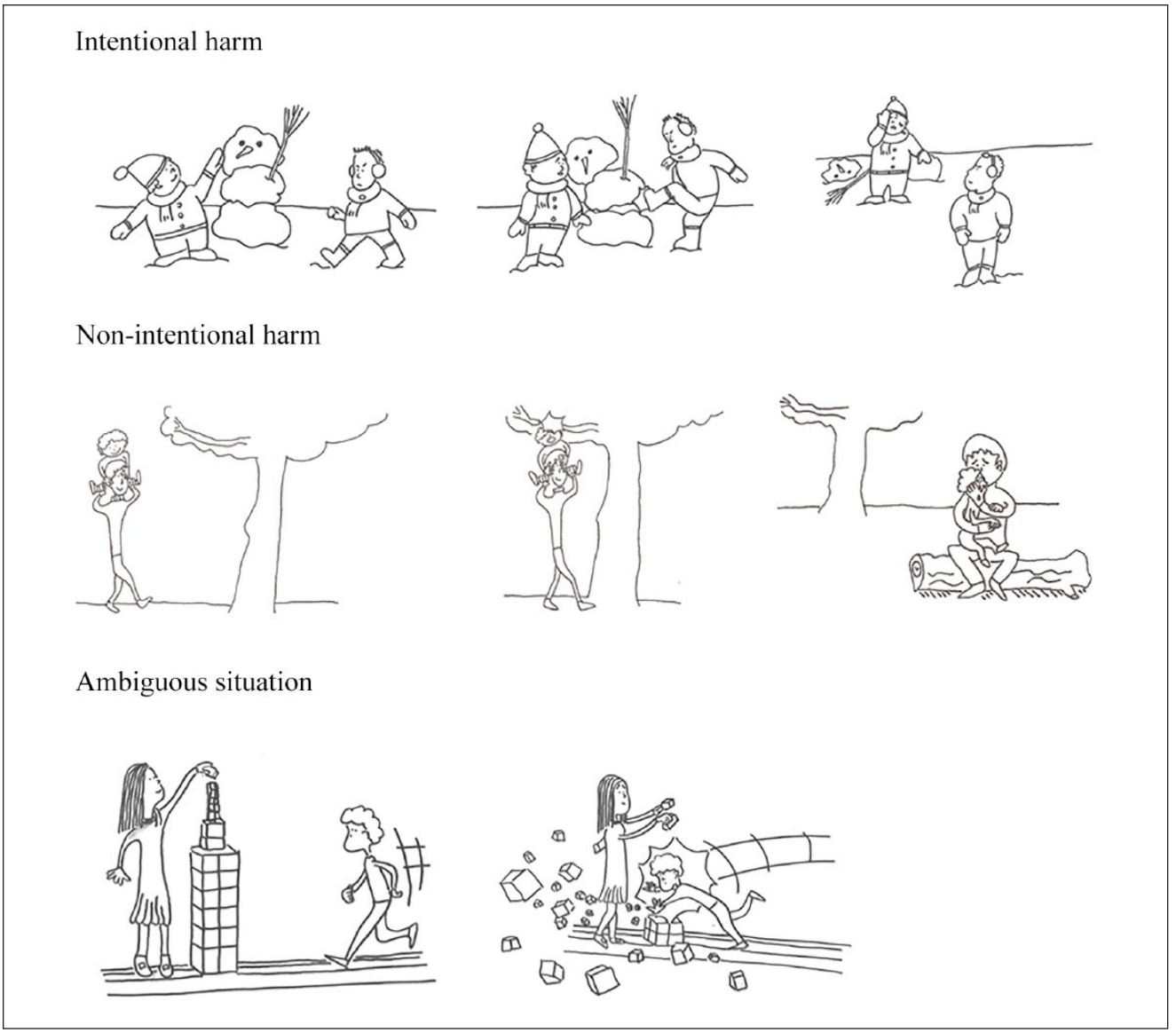

Figure 1. Examples of situations of intentional provocation, nonintentional harm, and ambiguous situations.

[pointing to the aggressor] do this [name action using the child's own words] on purpose?" For example: "Did this boy throw the ball at the other boy's head on purpose?" If the child does not understand the question, it can be reworded: "Did this child really want to [name the action using the child's words]." If the child still does not understand, he or she can be asked as follows: "Was that child mean on purpose?" Finally, if the child responds "I don't know," or "We can't tell" (when the strip is ambiguous), he or she is encouraged to make a choice by saying: "Just do your best and make a guess. Do you think he or she did it on purpose or that he or she didn't do it on purpose?" Thus, three types of responses are possible: spontaneous, after a probe question, or forced.

Scoring. For each item, a score of 0 is given when the intention attributed is nonhostile, and a score of 1 when the intention attributed is hostile. Then, three scale scores are calculated—a global score for the attribution of hostile intention (IAC-G score), corresponding to the sum of scores obtained on the eight ambiguous and the four nonintentional items and ranging from 0 to 12; a score for the ambiguous strips (IAC-A), ranging from 0 to 8; and a score for the nonintentional strips (IAC-NI), ranging from 0 to 4. It should be noted that in ambiguous situations there are no "right" answers, unlike in the nonintentional situations, where the child can misinterpret the intention. Intentional items are not included in the global scale because they do not measure hostile attribution bias (see item response

theory [IRT] models below). They are included in the IAC to counterbalance the possible influence of the nonintentional items on children's responses to ambiguous items. The type of response—spontaneous, after probe questioning, or forced—was also recorded for each item, and then the number of responses of each type was noted for each type of situation (ambiguous, intentional, and nonintentional) and for the test overall.

Social Perception Test. The SPT (Suess et al., 1992) was also administered to assess convergent validity between the IAC and the SPT. The coding for the SPT is binary: A score of 0 is attributed when the intention is seen as nonhostile and a score of 1 when the intention is rated hostile. The global score ranged from 0 to 6. To enable finer comparisons between the SPT and the IAC, two subscores were added: A score for the ambiguous strips and a score for the nonintentional strips, each ranging from 0 to 2.

Sociometry. The sociometry procedure used to test for convergent validity between social competence and the IAC is that proposed by Cassidy and Asher (1992). It consists in asking children to name or point out on a class photo the three classmates with whom they most like to play (most-liked) and the three classmates who they really do not like to play with (disliked). By gathering responses from the whole group, two sociometric scores, varying from 0 to 1, were calculated for each child and indicated the degree to which he or she is popular or rejected. These are proportion scores. The most-liked score (ML) corresponded to the number of times the child was named by other children in the class as being most liked, divided by the number of children in the class. The second was the disliked score (DL), corresponding to the number of times the child was named by others as disliked, divided by the number of children in the class.

Data Analytic Strategy

To assess validity of the IAC, its factor structure was examined using exploratory factor analyses and IRT models. Links between the IAC and the SPT were then tested. We expected moderate links, given the differences introduced in the IAC with regard to the type of scenes (interactions between children in the SPT vs. interactions between two children or between an adult and a child in the IAC), the diversity of items (6 different strips but only 3 different scenes in the SPT vs. 16 different strips and scenes in the IAC). The SPT and IAC also differ in terms of the instructions: in the IAC, contrary to the SPT, children are asked to imagine that they are the victim and, rather than being directly asked to attribute an intention, they are asked for a description of the situation and only then are they asked about the intention if not spontaneously specified. Finally, links between scores on the IAC and sociometric status were also examined to assess validity of the IAC. Sociometric status helps determine whether a child is popular within his or her group of peers. Rejected children are more likely than popular children to attribute hostile intentions in social situations (Feldman & Dodge, 1987; Keane, Brown, & Crenshaw, 1990; Villanueva, Clemente, & Garcia, 2000). For this reason, similar associations between sociometry and the IAC were expected. Links between sociometry and the SPT were also examined for comparative purposes.

Table 2. Scores for the Study Sample on the IAC, the SPT, and the Sociometry Measure.

Test	*M*	*SD*	Minimum	Maximum
IAC				
Global	3.53	2.63	0.00	12.00
Ambiguous	2.98	2.09	0.00	8.00
Nonintentional	0.55	0.89	0.00	4.00
SPT				
Global	3.05	1.15	1.00	6.00
Ambiguous	0.60	0.74	0.00	2.00
Nonintentional	0.53	0.71	0.00	2.00
Sociometry				
Most-liked	0.16	0.13	0.00	0.71
Disliked	0.14	0.15	0.00	0.85

Note. IAC = Intention Attribution Test for Children; SPT = Social Perception Test.

Results

Preliminary Analyses

The means, standard deviations, and ranges of scores on the IAC, the SPT, and the sociometry measure are presented in Table 2. As expected, mean scores on the IAC and on the SPT tend toward the maximal score for intentional situations, toward the minimal score for nonintentional situations, and are intermediate for ambiguous situations.

The percentages of hostile attribution bias, calculated according to the type of cartoon strip/scene (ambiguous vs. nonintentional), are presented in Table 3. The proportion of hostile attribution bias for the ambiguous scenes differs in expected ways from that for scenes representing nonintentional harm, $\chi^2(1) = 14.76$, $p < .001$, $\Phi = .25$. This scene effect can be explained by the fact that for the nonambiguous scenes, there is an expected response: attribution of nonhostile intention for the scenes showing nonintentional harm (the percentage of attributions of hostile intention should tend toward 0%). For the ambiguous scenes, however, the fact that there is no right answer can lead participants to attribute hostile as often as nonhostile intentions (the percentage of hostile attribution bias should thereby

Table 3. Percentages of Attributions of Hostile Intention for Each Scene/Cartoon Strip, According to the Type of Scene (Nonintentional Harm, Ambiguous Situations), and According to Whether the Protagonist Causing the Harm Is a Child or an Adult ($N = 233$).

Type of scene	Item	Provocative character	Attribution of hostile intention (%)
Scenes of nonintentional harm	3	Adult	7.3
	7	Child	20.5
	11	Adult	11.5
	15	Child	15.4
Average (nonintentional harm)			13.67
Ambiguous scenes	2	Adult	21.8
	4	Child	24.8
	6	Child	46.6
	8	Adult	41.5
	10	Adult	40.6
	12	Child	31.2
	14	Child	42.3
	16	Adult	49.1
Average (ambiguous scenes)			37.24

approach 50%). Despite these contrasts, certain particularities can be noted in the percentages obtained for certain scenes: the percentage for Strip 7 is quite high for a scene showing nonintentional harm (20.5%), close to the percentages for Scenes 2 (21.8%) and 4 (28.8%), which are ambiguous. Thus, certain scenes achieve a better consensus than others among those showing intentional harm and those showing nonintentional harm. The scenes with the lowest consensus are those that best discriminate among participants.

The results presented in Table 3 show that the percentage of hostile attribution bias also varied according to whether the character causing the harm in the scenes was an adult or a child. In situations of nonintentional provocation, participants more often attributed hostile intentions to children (17.9%) than to adults (9.4%), $\chi^2(1) = 13.77$, $p < .001$. In contrast, in situations where the provocation was ambiguous, the percentage of hostile attribution bias did not differ according to whether the protagonist was a child (36.2%) or an adult (38.2%), $\chi^2(1) = 0.09$, $p = .77$.

We also sought to determine whether the participants adapted to the test easily, on the basis of the types of response provided (spontaneous, after probe questioning, or forced). The results showed that most of the children responded either spontaneously (50% for ambiguous scenes, 53% for nonintentional scenes), or following a probe question (48% for ambiguous scenes, 46% for nonintentional scenes). Very few children (1% to 2%) needed to be obliged to respond, which suggests that the very large majority were able to adapt to the task.

Results reveal low but significant correlations between the type of response and hostile attribution bias: The more participants attributed hostile intentions for the ambiguous strips and overall, the less likely they were to respond spontaneously ($r = -.13$, $p = .04$ and $r = -.23$, $p < .001$) and the more they needed further probing ($r = .14$, $p = .003$ and $r = .23$, $p < .001$). Similarly, for the nonintentional strips, the more they responded correctly, the less likely they were to respond spontaneously ($r = -.38$, $p < .001$) and the more they needed further probing ($r = .32$, $p < .001$). Due to the very small number of cases of forced responses, no correlations were calculated for this type of response.

Factor Structure of the IAC

To examine the factor structure of the IAC, we ran an exploratory factor analysis (EFA) on the full 16 comics (items) using the psych package (Revelle, 2018) in R (R Core Team, 2018). Given that the individual items were binary in nature, we conducted the EFA based on the tetrachoric correlation matrix using weighted least squares estimation for factor extraction. The first EFA included a single factor on the full set of items (intentional, nonintentional, and ambiguous). Results revealed numerous estimation issues such as nonpositive definite matrices and Heywood cases, and pon inspecting the communalities, the intentional items had values near zero. Next, we ran a two-factor EFA using oblimin rotation which demonstrated that the intentional items loaded onto a second factor separately from the other items. Given the theoretical and statistical differences between the intentional comics (Items 1, 5, 9, and 13) and other comics, we decided that it is not appropriate to use the intentional comics to assess hostile attribution bias. Subsequent analyses included only the nonintentional (Items 3, 7, 11, and 15) and ambiguous comics (Items 2, 4, 6, 8, 10, 12, 14, and 16).

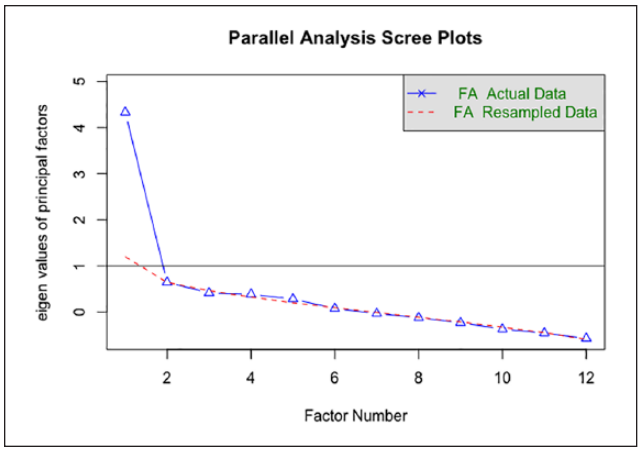

Figure 2. Parallel analysis of the ambiguous and nonintentional items.

Note. The number of factors to retain is equal to the number where the observed eigenvalues (and all previous ones) are above the dotted red line (resampled data). Resampled eigenvalues are based on the 99th percentile on 500 resampled datasets. This parallel analysis suggests a single factor.

Next, we repeated our EFA analyses above on the 12 remaining comics (nonintentional and ambiguous). Because the Kaiser criterion (raw eigenvalues $>$ 1 rule) often suggests retaining too many factors (Costello & Osborne, 2005; Flora & Flake, 2017; Preacher & MacCallum, 2003), we examined the eigenvalues based on the reduced correlation matrix instead. The eigenvalues in the reduced matrix suggests one factor since there was one value above 1 (4.33); the next largest eigenvalue was .63. We also examined results from a parallel analysis (Horn, 1965) in lieu of a regular scree plot. A parallel analysis plots the eigenvalues from the reduced correlation matrix against eigenvalues at the 95th or 99th percentile from simulated or randomly resampled data. The parallel analysis is included in Figure 2. Because the simulated data are generated from methods developed for continuous indicators, we opted to use the resampling method with 500 resampled data sets. From the figure, there is clearly a large difference for the first eigenvalue (single factor), but the second eigenvalue is very close to the randomly resampled value. Using the 95th percentile, the parallel analysis suggests retaining two factors, whereas it suggests retaining one factor at the 99th percentile. Unfortunately, research has found mixed results about the accuracy of parallel analysis for item-level data. Weng and Cheng (2005) found that parallel analysis on binary data using either the 95th or 99th percentile worked well for identifying unidimensionality, whereas others have suggested it performs relatively poorly (e.g., Tran & Formann, 2009; Yang & Xia, 2015). Instead, we focus on interpreting the factor loadings and communalities across the competing EFA models. Table 4 includes the EFA results for both the one and two-factor solutions. Results do not appear to substantively improve in interpreting the two-factor model. While the addition of a second factor generally captures the nonintentional comics, Comics 11 and 15 have factor loadings of approximately equal magnitude across both factors, and there is an ambiguous comic (Item 2) that loads highly onto the second factor as well. Of note, Comics 6 and 10 have relatively low communalities/loadings in both models which may suggest that they are not good items for assessing hostile attribution bias. Based on a balance of interpretability and the statistical results, we decided that a one-factor solution (measuring hostile attribution bias) was the appropriate interpretation of the dimensionality for the IAC.

Item Response Theory (IRT) Analysis of the IAC

To examine the IAC further, we conducted a unidimensional two-parameter logistic (2PL) IRT model on the 12 items using the mirt package (Chalmers, 2012) in R (R Core Team, 2018). The 2PL model was estimated using maximum marginal likelihood with an expectation-maximization (EM) algorithm.

Model fit was interpreted using the following indices: the chi-square and the ratio of the chi-square to its degrees of freedom (χ^2/df ratio), comparative fit index (CFI), root mean square error of approximation (RMSEA), and the standardized root mean square residual (SRMR). We considered the model acceptable when the χ^2/df ratio is 2 or under (IBM, 2014), CFI is greater than .90 (acceptable; Meganck, Markey, & Vanheule, 2012) or .95 for good fit (Hu & Bentler, 1999), RMSEA is less than .08 (MacCallum, Browne, & Sugawara, 1996), and SRMR is less than .08 (Hu & Bentler, 1999).

Based on the fit index cutoffs detailed above, the model demonstrated good model fit, $\chi^2(54) = 90.43$, $p = .001$, $\chi^2/df = 1.67$, CFI = .94, RMSEA = .05 with 90% confidence interval [.03, .07], SRMR = .07.

Item-Level Information. Figure 3 includes item-level information from the IRT model. The item characteristic curves (ICCs) are presented in the left panel and the item information curves (IICs) are presented in the right panel. The discrimination/slope (a) and difficulty (b) parameters are also included for each ICC in the figure. The slope parameters describe how strongly the item is related to the standardized latent trait, hostile attribution bias (denoted as θ), whereas the difficulty parameters represent the score on θ where a person would have a 50% probability of rating the action in the comic as intentional. From the figure, one can see that there is a range in slope and difficulty parameters across the different comics. Comics 6 and 10 display the flattest slope suggesting that these are not particularly good items for discriminating between children with different degrees of hostile attribution bias. All of the comics include a positive difficulty parameter suggesting that children at average or

Table 4. EFA Results From One- and Two-Factor Models on the Ambiguous and Nonintentional Comics.

	One-factor solution		Two-factor solution		
Item	F1 Loading	Communality	F1 Loading	F2 Loading	Communality
2	.60	.36	.15	**.56**	.42
3	.64	.41	−.08	**.91**	.76
4	.64	.41	**.43**	.30	.41
6	.34	.11	.19	.20	.11
7	.51	.26	.09	**.52**	.32
8	.62	.39	**.70**	−.01	.49
10	.41	.17	**.56**	−.11	.26
11	.66	.43	**.37**	**.39**	.44
12	.64	.40	**.61**	.09	.44
14	.65	.42	**.61**	.11	.45
15	.81	.65	**.44**	**.47**	.64
16	.56	.31	**.73**	−.12	.46
R^2	.36	Total of .36	.25	.19	Total of .43

Note. EFA = exploratory factor analysis. R^2 refers to the proportion of variance in the set of observed variables accounted for by the factors. In the one-factor model the factor refers to hostile attribution, in the two-factor model F1 refers to ambiguous hostile attribution and F2 refers to incorrect hostile attribution. In the two-factor solution, factor loadings over .35 are bolded to highlight a sizeable loading onto one or more factors.

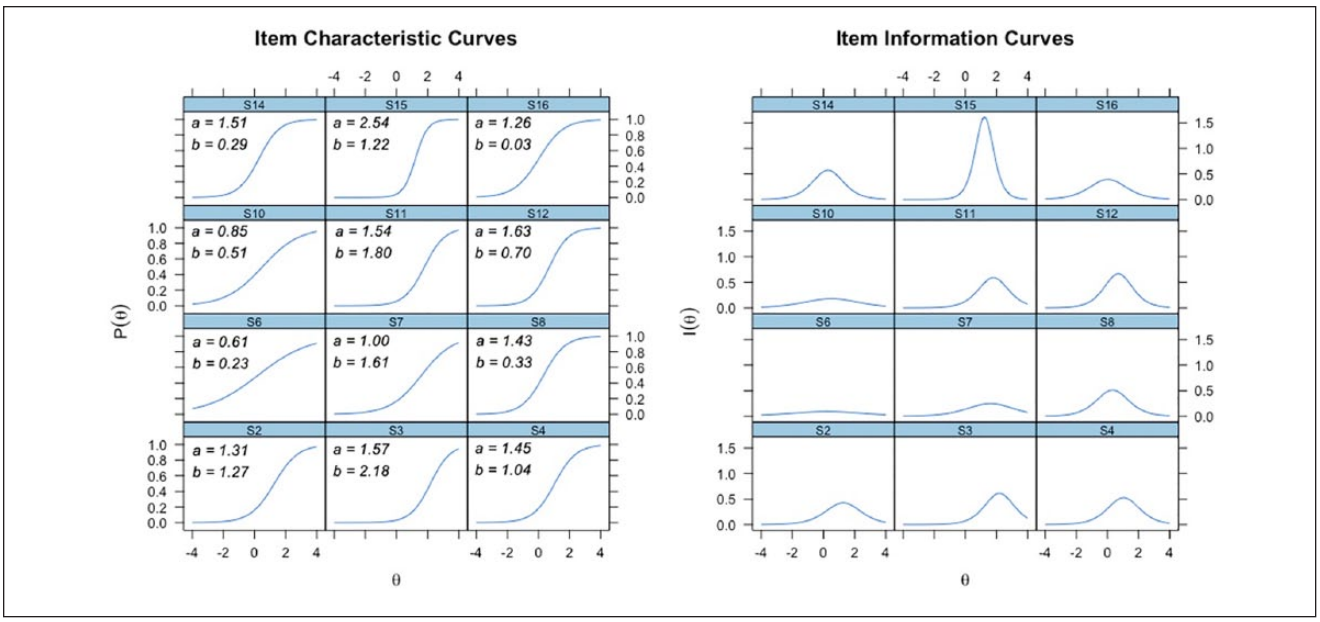

Figure 3. Item-level information from 2PL IRT model for nonintentional and ambiguous IAC items.
Note. IRT = item response theory; IAC = Intention Attribution Test for Children. In both panels, the *x*-axis represents standardized values of the latent trait, intentional attribution. In the left panel, the *y*-axis represents the probability of identifying the item as intentional. In the right panel, the *y*-axis represents scores about how much the item contributes to the test-level information. In both panels, the middle column represents nonintentional items and the left and right columns are ambiguous items.

higher levels of the latent trait (hostile attribution) have a 50% probability of attributing hostile intentions across any given item. Unsurprisingly, children need higher levels to attribute hostile intentions in the nonintentional comics. From the IICs, we can see that some comics provide more information in measuring the latent trait than others. For example, Comic 15 provides a lot of information toward measuring hostile attribution, whereas Comics 6 and 10 provide relatively little information.

Test-Level Information. Figure 4 includes test-level information. The left panel demonstrates that the IAC is best for

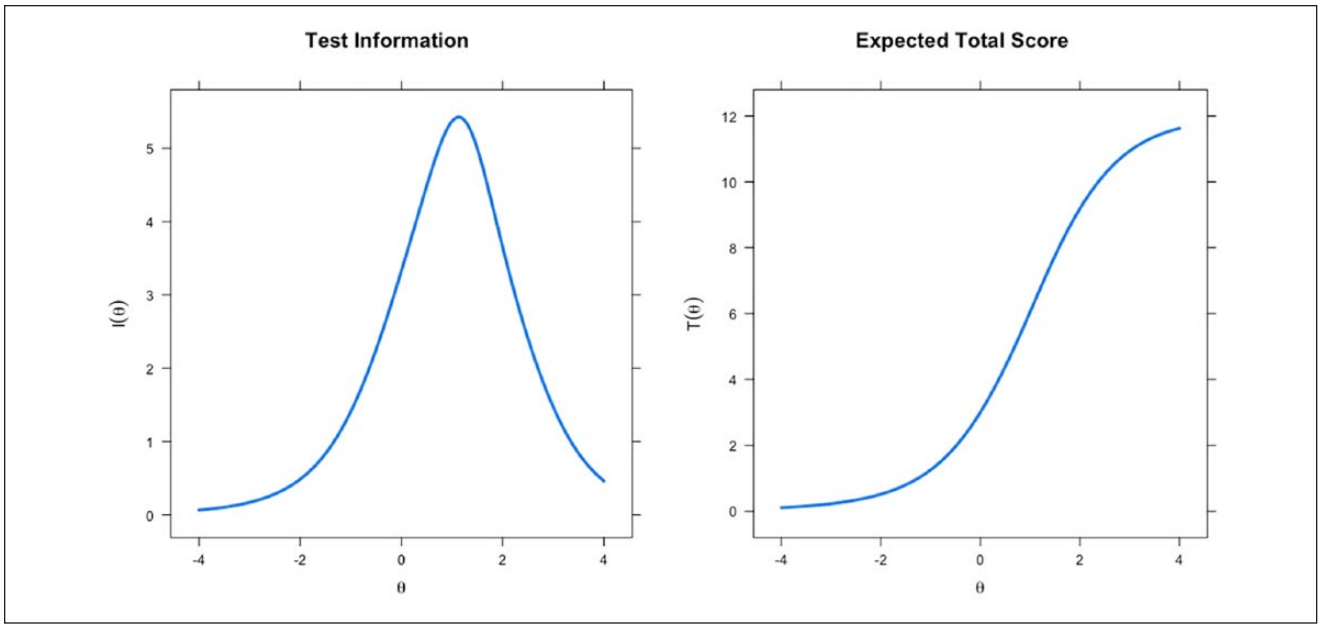

Figure 4. Test-level information from 2PL IRT model for nonintentional and ambiguous IAC items.
Note. IRT = item response theory; IAC = Intention Attribution Test for Children. In both panels, the X F represents standardized values of the latent trait, intentional attribution. In the left panel, the *y*-axis represents the amount of information contributed by the full IAC measure across the range of the latent trait, intentional attribution. In the right panel, the *y*-axis represents the expected total score across the range of the latent trait, whereby 12 represents the highest possible score.

measuring average to higher levels of hostile attribution, whereas the test provides little information about those with lower than average scores on the latent trait. This is demonstrated by the higher area under the curve between 0 and 2. The right panel demonstrates the expected total score on the IAC for children across a large range of the latent trait, hostile attribution. Note that one should expect a total score of 4 for average levels of the trait as this represents correctly rating the nonintentional items as nonintentional, as well as rating 50% of the ambiguous items as intentional. The expected score plot demonstrates exactly this relationship, whereby children with hostile attribution latent scores slightly above average (i.e., 0.23, where 0 = average) are expected to have an observed total score of 4. Despite the variation of the slope and difficulty parameters across different comics, the empirical reliability of the IAC as a whole was 0.73. To reiterate the results in test-level information, the IAC appears to be most reliable for children with average to somewhat higher hostile attribution bias.

Correlates of the IAC

We calculated convergent validity between the scores obtained on the IAC and the SPT using Pearson correlations. Our hypothesis was that these two tasks measured the same concept of hostile attribution bias, but that the correlations should only be moderate, given the differences introduced in the IAC for the instructions and the diversity of scenes presented. We also calculated convergent validity between the IAC scores and those obtained on the sociometry measure (Cassidy & Asher, 1992), and expected a positive association between hostile intention bias and the "disliked" score. To control for the possible effects of age and gender on IAC, SPT, and sociometry scores (see, for instance, Yagmurlu, 2014 or Pettit, Dodge, & Brown, 1988), associations between these variables were first examined.

Table 5. Mean Scores on the IAC, According to Type of Scene and Age (N = 233).

Age, years	*n*	Global/12	Ambiguous/8	Nonintentional/4
4	32	5.69	4.22	1.47
5	41	3.78	3.02	0.76
6	20	2.40	2.05	0.35
7	28	2.65	2.14	0.51
8	41	3.47	3.15	0.32
9	23	2.74	2.57	0.17
10	12	3.08	2.92	0.16
11	10	3.50	3.00	0.50
12	26	3.35	3.12	0.23

Note. IAC = Intention Attribution Test for Children.

The mean scores for hostile attribution bias for each subscale of the IAC (i.e., ambiguous, nonintentional, and global) according to age are presented in Table 5. A linear regression line and a cubic regression curve were added to

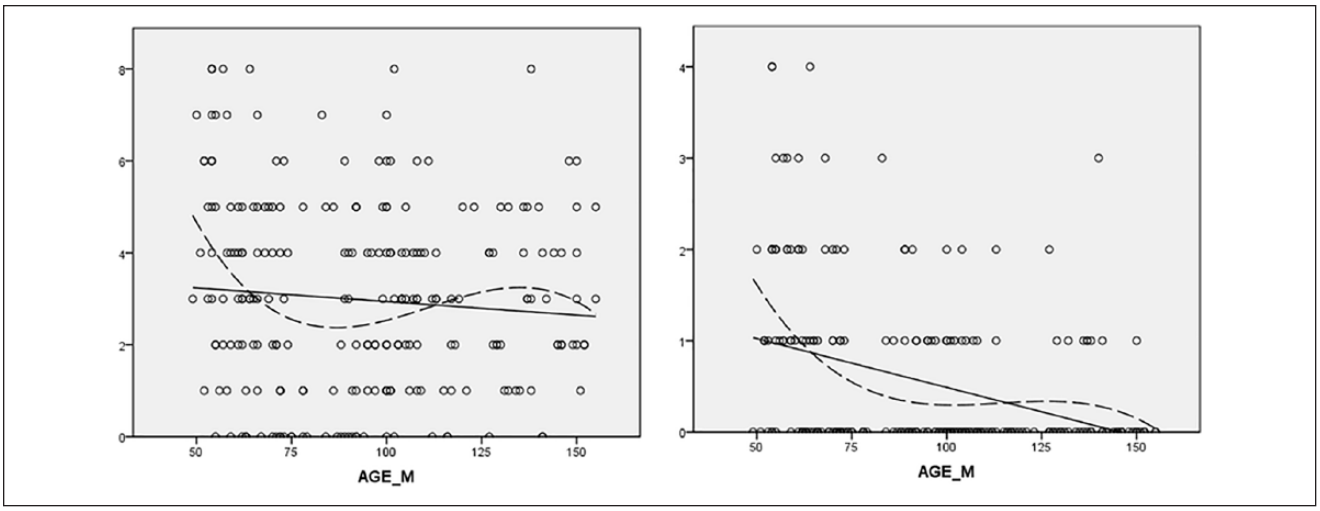

Figure 5. Distribution of scores for attribution of hostile intention for the two types of items—ambiguous (figure on the left) and nonintentional (figure on the right)—according to age in months.

Table 6. The Effects of Age on the IAC, the SPT and Sociometry.

	IAC			SPT			Sociometry	
	Global	Ambiguous	Nonintentional	Global	Ambiguous	Nonintentional	Most-liked	Disliked
Age, *r*	.11	−.08	−.36**	−.12	.02	−.24**	−.21**	−.29**

Note. IAC = Intention Attribution Test for Children; SPT = Social Perception Test.
*$p < .05$. **$p < .01$.

the graphs in Figure 5. As there was no breakpoint in the curve, age was tested as a continuous value.

To determine which variables needed to be controlled for, correlations of age with the IAC, the SPT, and sociometry were calculated (see Table 6) and effect of gender was tested. There was no effect of gender on the different variables of interest (all $t_s < 1.49$, all $p_s > .09$). Age was correlated with the three measures. Consequently, age was included as a control variable when investigating links between the IAC, the SPT, and sociometry. Results (see Table 6) showed that age was correlated with nonintentional items of the IAC and the SPT (decrease in the number of errors with age, $r = -.36$, $p < .001$ and $r = -.24$, $p = .004$) but not with ambiguous items ($r = -.08$, $p = .202$ and $r = .02$, $p = .825$). Kuder-Richardson 20 coefficient (KR-20) were calculated to obtain a measure of consistency between the different situations according to age group. We formed age groups ensuring that the numbers in each were large enough. The results indicate that the KR-20 values for the IAC are good for children aged 4 to 7 years ($.74 <$ KR-20 $< .81$) and that they decrease for children aged 8 to 12 years ($.47 <$ KR-20 $< .59$).

Correlations Between the IAC and the SPT. The results presented in Table 7 reveal positive correlations between the SPT and the IAC for global scores ($_{partial}r = .57$, $p < .001$), for ambiguous situations ($_{partial}r = .42$, $p < .001$), and for nonintentional harm ($_{partial}r = .41$, $p < .001$).

Correlations Between the IAC and Sociometry. The "disliked" score on the sociometric scale was positively correlated with IAC global scores ($r_{partial} = .30$, $p < .001$), with IAC scores for ambiguous situations ($r_{partial} = .25$, $p = .001$), and with IAC scores for situations of nonintentional harm ($r_{partial} = .32$, $p < .001$). The "most-liked" score was not linked to any of the three IAC scores (all $r_s < .06$; all $p_s > .20$; see Table 7).

Correlations between sociometry and the SPT were also calculated. The "disliked" score on the sociometric scale was also positively correlated with SPT global scores ($r_{partial} = .27$, $p = .006$), with SPT scores for ambiguous situations ($r_{partial} = .22$, $p = .025$), and with SPT scores for situations of nonintentional harm ($r_{partial} = .18$, $p = .046$). The "most-liked" score was not linked to any of the three SPT scores (all $r_s < .17$; all $p_s > .09$; see Table 7).

Table 7. Correlations Between Scores on the IAC, the SPT, and Sociometry, Controlled by Age.

	IAC			SPT		
Test	Global	Ambiguous	Nonintentional	Global	Ambiguous	Nonintentional
SPT, *r*						
Global	.57**	.52**	.42**			
Ambiguous	.43**	.42**	.25**			
Nonintentional	.46**	.39*	.41**			
Sociometry, *r*						
Most-liked	−.06	.06	.05	−.01	−.07	−.01
Disliked	.30**	.24**	.32**	.27**	.22*	.20*

Note. IAC = Intention Attribution Test for Children; SPT = Social Perception Test.
*$p < .05$. **$p < .01$.

Discussion

The IAC was developed to improve on psychometric limitations of currently existing measures of hostile attribution bias in situations of harm among preschool and school-age children. We further sought to create an instrument that is easy to use in both research and clinical settings. The IAC includes 16 comics composed of four items depicting intentional harm, four depicting nonintentional harm, and eight that depict harm in an ambiguous way (it is not clear whether the harm is intentional). The goal is to determine whether the child perceives the action as intentionally hostile.

Psychometric Validation

Our results demonstrated that the children in our sample understood the task and responded meaningfully to questions about the comics. Based on similar measures in the literature (e.g., SPT; Suess et al., 1992), we sought to demonstrate the validity of including a total score for the 16 comics. IRT and factor analytic models revealed that the intentional items did not contribute to the same overall construct of hostile intention attribution bias. From a theoretical perspective, this finding makes sense. A child who correctly rates a comic depicting intentional harm as intentional is not demonstrating a bias toward hostile intention attribution, but is simply correctly identifying the nature of the comic. Regardless of having an intentional attribution bias, children are equally likely to rate these comics as intentional. Based on our statistical findings and theoretical framework, we do not recommend including a total score that includes scores from the intentional comics. Instead, we advocate calculating a total score that includes only the ambiguous and nonintentional items which was validated by finding good model fit in an IRT model measuring a single dimension of the remaining 12 comics.

We also found good internal consistency of the measure with the 12 items (ambiguous and nonintentional) and the distribution of IAC global scores suggests that they are representative of the full range of scores in the sample. Moreover, results showed superiority of IAC internal consistency over SPT internal consistency. Results also provided evidence of construct validity via strong correlations between the concept of social competence, measured with a sociometric assessment, and the hostile attribution bias in situations of harm measured on the IAC. The results indicated that the more a child was disliked by his or her peers, the more likely he or she was to attribute hostile intentions in situations of nonintentional harm or in ambiguous situations. This finding is in line with earlier studies (Dodge, Murphy, & Buchsbaum, 1984; Feldman & Dodge, 1987; Keane et al., 1990; Quiggle et al., 1992; Villanueva et al., 2000) and points to the interrelation between interpretation of social situations and social acceptance.

Relationship Between the IAC and the SPT

Our results suggest relatively good convergent validity between the IAC and the SPT (the instrument from which the IAC was derived). Moderate links between the two instruments were found for the ambiguous and nonintentional situations. We argue that the IAC is preferable to the SPT for several reasons. The possibility of responding spontaneously on the IAC in comparison with closed questions in the SPT, the deliberate identification with the victim, and the diversity of scenes staged in the IAC, may elicit a greater diversity of responses, as each item can echo specific experiences, leading to more nuanced biases than in the SPT. Similarly, the IAC includes both child and adult perpetrators, important because adult–child and child–child interaction are interdependent developmental processes, both key to early socialization (Parke & Ladd, 1992/2016). Furthermore, the IAC includes a larger number of comics to help create a more reliable assessment of similarly themed comics. In addition, the IAC permits assessment of intention bias with a single instrument across a broad age span (4- to 12-year-olds), thereby excluding method confounds

and facilitating longitudinal study. Last, as discussed above, we do not agree that items that depict intentional harm should be included in a total score measuring intentional attribution bias.

Agent Causing the Harm: Child or Adult

Children's perception of intention in other people varied according to whether it was a child or an adult who was involved in the situation of harm only in nonintentional situations. In these situations, participants gave less emphasis to the clue of nonintentionality for children than for adults: they more often showed a hostile attribution bias for strips with children only. In ambiguous situations, the processing of information was different; responses did not vary according to whether it was a child or an adult who was involved in the harm. The absence of clues related to intentionality led to a general attribution bias, not specific to adults or children.

The IAC and the Effect of Age and Cognitive Development

The results evidenced an effect of age on the attribution of intention for the nonintentional scenes, with a decrease in the number of errors with age. The effect of age may be due to the development of executive functions. Because attentional resources increase with age, older children can integrate different aspects of the cartoon strips, whereas younger ones base their judgment on only the most obvious indices. The fact that the effect of age was not significant for ambiguous scenes, for which indices of intentionality are not present, is consistent with this hypothesis.

In situations of nonintentional harm, errors committed by young children may be due to the possibility that they solely focus on the damage done. The negative impression induced by harm may lead them to spontaneously attribute hostility. To inhibit this negative state and derive a correct interpretation, it is necessary to consider indices of nonintentional harm. These findings are consistent with previous ones on moral judgment (e.g., Cushman, Sheketoff, Wharton, & Carey, 2013), which suggest that young children focus on outcome more than on intention.

It is important to note that the internal consistency of the IAC varied by age group; it was high for children aged 4 to 7 years, but decreased for children aged 8 to 12 years. This drop in internal consistency could reflect more subtle and differentiated perceptions on the part of older children. It can be hypothesized that the intentions attributed vary more from one ambiguous situation to another for children older than 8 years as a result of more flexible reasoning (Dick, 2014), which enables a fresh appraisal of each item and the generation of more specific responses. Younger children, for their part, may respond to ambiguous items on the basis of representations of situations of harm that are less flexible and less adapted to each situation. The fact that they more readily attributed the same intention to ambiguous provocation scenes may explain why their responses showed greater internal consistency. Consequently, lower consistency for the 8- to 12-year-olds may be due to developmental factors and not constitute, per se, a limitation of the instrument. From a developmental point of view, these findings suggest that hostile attribution bias on nonintentional items may be due to cognitive limitations among young children but to personal characteristics among older ones. These findings are analogous to long-standing findings (Nagin & Tremblay, 1999; Robins, 1978) indicating that for some children, rates of aggression, opposition, and hyperactivity externalizing behavior dimensions decline with age, while for others, they do not (desisters and nondesisters). The current data raise two developmental questions: (a) Under what conditions do some children continue with high attributional bias while others desist, and (b) Does continued high attributional bias underlie ongoing externalizing behavior?

Future Directions

Given some of the observed differences by age group, a crucial next step for this research would be a differential item functioning analysis across age groups. This analysis will help ensure that the comics contribute to the construct of hostile attribution bias similarly across different age groups. Further research examining the impacts of age with the scale could also help identify the age at which nonintentional items can be used to identify difficulties in understanding intentions and above which errors actually reflect hostile attribution bias. Another important extension to this work is to further examine the role of the intentional comics. For example, they could be used as a validity check. Because these items do not reflect hostile attribution bias, it is possible that errors reveal random responses or difficulties in understanding the task or the presented intentions. To use these items as a validity check, determination of a cutoff score is needed.

Summary

In conclusion, the results of our study provide psychometric evidence that the IAC has good validity, internal consistency, and distributional properties. Our statistical findings reveal a number of reasons for which the IAC should be preferred over the SPT. Although ongoing research about age effects is important, the measure can be used with preschool to school-age children, unlike other measures of

hostile attribution bias. The IAC may be a useful instrument for research but also in therapeutic interventions addressed to children with attributional biases.

Authors' Note

The cartoon strips are available on each author's profile on www.researchgate.net.

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Supplemental Material

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