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Can Adolescents With Williams Syndrome Tell the Difference Between Lies and Jokes?

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A group of adolescents with Williams syndrome (WS) was compared to matched groups of adolescents with Prader–Willi syndrome and nonspecific mental retardation on a task that tested the ability to distinguish different forms of nonliteral language. Participants listened to stories that ended in either a lie or an ironic joke. They were asked to decide the form of the nonliteral utterance and justify their responses. Almost none of the participants in any of the groups were able to correctly classify the ironic jokes, instead judging them to be lies because they did not correspond to reality. Their errors were similar to those made by younger normally developing children, but contrasted with those made by brain-damaged adults. These data are taken as further evidence that neurodevelopmental disorders are quite different from acquired brain disorders and require different neuropsychological models. The findings from this study also have important implications for considering the difficulties that adolescents with WS and other disorders will have in everyday social situations, especially among peers.

Effective communication entails the capacity to handle both literal and nonliteral forms of language. The essence of communication is the ability to interpret the

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speaker's intended meaning, whether the speaker uses literal language, where intended meaning matches surface structure, or nonliteral language, where form does not match intended meaning. Our everyday discourse incorporates both forms, including metaphor, irony, sarcasm, and indirect or elliptical utterances, and speakers often use a variety of cues, especially nonverbal cues, to convey intended meaning. Current theories of pragmatics emphasize that the capacity to interpret intended meaning in both literal and nonliteral utterances lies at the intersection between language and social cognition, specifically theory of mind (e.g., Sperber & Wilson, 1986). This perspective highlights the fact that only when the mental states of the speaker and the listener are clearly understood can one make an accurate interpretation of intended meaning in nonliteral utterances. An inability to decipher the communicative intent of the speaker would seriously compromise one's ability to make sense of much of our everyday conversation.

Thus far there has been little research exploring the use or interpretation of nonliteral language in individuals with Williams syndrome (WS). Given their unique cognitive and personality phenotype, one might hypothesize that people with WS would have little difficulty with nonliteral language. We know that language itself is a relative strength (Bellugi, Mills, Jernigan, Hickok, & Galaburda, 1999; Mervis, Morris, Bertrand, & Robinson, 1999), and that children with WS are effective in conversation with others, especially adults (Bellugi, Jones, Harrison, Rossen, & Klima, 1995; Kelley & Tager-Flusberg, 1995). Anecdotal reports of their discourse skills, especially narratives, indicate that their language is often filled with colorful descriptions including metaphors and idioms (Bellugi, Bihrle, Neville, Jernigan, & Doherty, 1992), and they are skilled at using prosodic features to express speaker attitude (Reilly, Klima, & Bellugi, 1990). People with WS are also known for their warm empathic personality and keen interest in other people (Gosch & Pankau, 1997; Udwin & Yule, 1991). Thus the WS profile seems to incorporate the main characteristics—good language and social interest—that would be needed to interpret speakers' intended meaning in both literal and nonliteral forms of language.

In normally developing children, the ability to distinguish between literal and nonliteral forms of language emerges between 5 and 8 years of age (Andrews, Rosenblatt, Malkus, Gardner, & Winner, 1988; Happé, 1993; Leekam, 1991; Sullivan, Winner, & Hopfield, 1995; Winner, 1988; Winner & Leekam, 1991; Winner, Windmueller, Rosenblatt, Bosco, & Best, 1987). By 5 years of age, children are able to distinguish between metaphor and irony (Happé, 1993), and between ironic jokes and lies (Leekam, 1991). Somewhat later, children begin to distinguish between sarcasm and other forms of falsehood (Winner et al., 1987).

Research has also shown that children's ability to distinguish among various forms of falsehood is related to their theory of mind abilities, namely, their ability

to understand the mental states of the speaker and listener. To distinguish between forms of nonintentional and intentional falsehoods (e.g., mistakes vs. lies), one must be able to conceptualize the speaker's first-order mental state. For example, a mistaken speaker believes what he or she says is true, and thus intends to be truthful. On the other hand, a liar does not believe what he or she says is true, and thus intends to deceive. To distinguish between forms of intended falsehood (e.g., lies vs. irony), one must be able to conceptualize more complex or higher order mental states (e.g., what the speaker knows the listener knows [second-order knowledge], what the speaker intends the listener to believe [second-order intention], what the speaker believes the listener believes [second-order belief]). In the case of an ironic joke, the speaker knows that the listener knows the truth, and thus does not intend to deceive, whereas the liar believes that the listener does not know the truth, and thus intends to deceive. Thus, the ability to distinguish among different forms of nonliteral and literal language rests on the ability to understand the intentions and related knowledge states of the speaker.

Early studies demonstrated that by the time children are able to understand a speaker's first-order false belief (4 years of age), they are also able to distinguish mistakes from lies (Wimmer & Perner, 1983; Wimmer, Gruber, & Perner, 1984, 1985) and are able to comprehend metaphor (Happé, 1993). More recently, several studies have demonstrated a strong association between understanding of various complex mental states and intentional falsehood (Happé, 1994; Leekam, 1991; Sullivan et al., 1995; Winner & Leekam, 1991). For example, Sullivan et al. (1995) showed that the ability to conceptualize the second-order knowledge state of the speaker (e.g., she knows that he knows) is necessary to distinguish lies from ironic jokes, suggesting that certain mental states may be more relevant than others for these types of linguistic distinctions. In the majority of these studies, children's mental state understanding precedes lie/joke comprehension by approximately 2 years, which suggests that understanding of complex mental states is necessary but not sufficient.

This relationship between theory of mind and nonliteral language has also been demonstrated for atypical and brain-damaged populations. Happé (1993) found that whereas individuals with autism passing first-order theory of mind tasks understood metaphor, only those passing second-order tasks understood irony. Winner, Brownell, Happé, Blum, and Pincus (1998) found that in adults with right-hemisphere brain damage (RHD), who have known difficulties with discourse interpretation, the ability to distinguish lies from jokes was also strongly correlated with measures of second-order belief. Their study, which used a task based on one developed by Sullivan et al. (1995) for children, found that although the relation between higher order mental states and lie/joke discrimination was present in the RHD individuals, their error pattern was quite different from what had been found in normally developing children. Thus, children who fail to

distinguish between lies and jokes tend to judge all the nonliteral utterances as lies. In contrast, the RHD individuals who failed the task were as likely to judge the lies as jokes as they were to judge the jokes as lies. This suggests that these individuals do not use a developmentally primitive strategy (to take all nonliteral utterances as lies) and highlights the differences between how children and adult brain-damaged individuals process socially relevant stimuli. Nevertheless across all the groups that have been studied thus far, the ability to distinguish between various forms of intended falsehood rests on the ability to conceptualize the second-order mental states of the speaker.

Only one study has examined the ability of adolescents and adults with WS to interpret nonliteral language. Karmiloff-Smith, Klima, Bellugi, Grant, & Baron-Cohen (1995) conducted a series of experiments with a group of individuals with WS demonstrating their relatively spared theory of mind abilities, including their ability to interpret intended meaning. Their work, however, has been criticized for not including appropriately matched comparison groups, especially other groups of individuals with mental retardation (e.g., Sullivan & Tager-Flusberg, 1999), and for including small samples of participants varying widely in age. Karmiloff-Smith et al. (1995) used a task designed by Happé (1993) to test the participants' ability to understand metaphor and sarcasm. Half of the participants with WS in their study succeeded on both the metaphor and the sarcasm statements, though it is not clear whether these were the same participants who passed their second-order knowledge task.

In contrast to the findings reported by Karmiloff-Smith et al. (1995), other studies have not found theory of mind abilities to be spared in either children (Tager-Flusberg & Sullivan, 2000; Tager-Flusberg, Sullivan, & Boshart, 1997) or adolescents with WS (Sullivan & Tager-Flusberg, 1999). When compared to other groups of retarded individuals, matched on age, IQ, and language level, children and adolescents do not perform better on either first-order or second-order tasks that require them to attribute knowledge and belief states to story characters. Given these findings, we hypothesize that adolescents with WS would not be able to distinguish between different forms of nonliteral language, especially those that entail the attribution of higher order mental states to other people.

The goal of this study was to test this hypothesis, using the task designed by Sullivan et al. (1995). As in our previous research on theory of mind in WS, in this study we compared adolescents with WS to age-matched individuals with Prader–Willi syndrome (PWS), another rare genetic disorder, and children with nonspecific mental retardation. Neither of these groups has the striking cognitive or personality phenotypes that are typical of WS. At the same time, the IQ distribution in these groups is fairly comparable to the range found in WS, making it easy to identify participants who are matched on IQ. Moreover, given the variation in language levels across all these groups, it is possible to select groups that are well matched across all these variables.

METHOD

Participants

Three groups participated in this experiment: children and adolescents with WS, PWS, and nonspecific mental retardation (MRU). Table 1 presents the main characteristics of these groups. The first group included 16 adolescents with WS (9 girls and 7 boys) all of whom had previous confirmed clinical diagnoses of WS. Participants were either tested at the 1996 National Williams Syndrome Association Family Conference (11 participants) or referred from the New England Williams Syndrome Association and the National Williams Syndrome Association for local children and tested in their homes (5 participants).

The second group included 11 adolescents with PWS (2 girls and 9 boys), all of whom had received clinical diagnoses of PWS. Most of the adolescents with PWS (9 participants) were tested at the 19th Annual Prader–Willi Syndrome National Conference in 1997. The other 2 participants were referred by the Prader–Willi Association of New England and tested in their homes. Although participants in the WS and PWS groups were not required to provide documented evidence of genetic

TABLE 1
Participant Characteristics

	Williams Syndrome[a]	*Prader–Willi Syndrome*[b]	*Nonspecific Mental Retardation*[c]
Chronological age			
M	12.3	12.8	12.00
SD	1.1	2.9	2.7
Range	8.4–16.7	10.1–17.1	9.0–15.2
PPVT–R mental age			
M	9.0	9.7	7.9
SD	2.7	2.9	2.7
Range	4.8–15.6	3.3–13.1	5.0–11.8
PPVT–R standard score			
M	77.2	78.5	64.4
SD	14.6	15.2	18.8
Range	46–107	55–101	34–86
Full-scale IQ			
M	65.7	75.1	66.5
SD	12.2	12.7	5.7
Range	52–96	55–97	60–76

Note. PPVT–R = Peabody Picture Vocabulary Test–Revised.
[a]$n = 16$. [b]$n = 11$. [c]$n = 12$.

testing, only those with confirmed clinical diagnoses (through parental report and medical documentation) were included in the study. Unclear cases were excluded.

The third group included 12 adolescents with MRU (7 girls and 5 boys), drawn from special education classes in local public schools. In all cases the etiology of the mental retardation was unknown.

All participants were administered Form M of the Peabody Picture Vocabulary Test–Revised (PPVT–R; Dunn & Dunn, 1981), a receptive one-word vocabulary test. The majority of participants also received the Kaufman Brief Intelligence Test (K–BIT; Kaufman & Kaufman, 1990) as a general measure of cognitive level. The K–BIT yields verbal and nonverbal domain scores, as well as an overall IQ score. Three (19%) of the WS and 2 (18%) of the PWS participants were administered the Differential Abilities Scales (DAS; Elliot, 1990). The DAS yields verbal, nonverbal, and spatial domain scores, as well as an overall composite score (GCA), which is equivalent to a Full-Scale IQ score. The full-scale equivalents yielded by these two IQ measures have been shown to be highly correlated (Kaufman & Kaufman, 1990). Analyses of variance (ANOVA) confirmed that at a group level there were no statistically significant differences among the groups on chronological age ($p < .69$), PPVT–R mental age ($p < .40$), PPVT–R standard score ($p < .32$), or Full-Scale IQ ($p < .14$). However, because the p value of the IQ variable was somewhat low, we have treated IQ as a covariate in the relevant analyses.

Materials

Participants were presented with four stories based on the task developed by Sullivan et al. (1995). The stories described situations in which an adult knows that a child has not completed a required chore. In all stories, the child utters a literal falsehood that the adult knows is false (e.g., "I did a great job cleaning up my room"); in two of the stories the false statements were lies, in two they were ironic jokes. In the lie stories, the child does not know that the adult knows the truth. The liar intends for the listener to believe him and thus be deceived. In the joke stories, the child does know that the adult knows the truth and thus does not intend to deceive the listener. Thus, the only structural difference between the lie and the joke stories was the child's second-order belief about the adult's knowledge of the truth. The Appendix presents both the lie and the joke versions of one of the stories.

Procedure

Participants were first given a training session to ensure that they understood the correct usage of the terms "lie" and "joking or just kidding." One experimenter (E1) showed the participant the contents of a small box (a tiny doll) without letting a second experimenter (E2) look inside. E2 then asked E1 what was in the box. E1

replied in a sincere tone of voice that the box was empty, and then asked the participant whether the answer was a lie or a joke. After a correct response, participants were told, "That's right, I was lying. I knew that she couldn't see what was in the box, so I lied and told her it was empty." Following an incorrect response, E1 said, "Well, really, I was lying. I knew that she couldn't see what was in the box, so I lied and told her it was empty." Next, E1 showed both the participant and E2 a small box containing a small dog and said in a joking intonation, "Hey look, this dog is really big." The participant was again asked if the answer was a lie or a joke. After a correct response, participants were told, "That's right, I was just kidding or joking. I knew that she could see the tiny dog, so I was just kidding when I said it was really enormous!" Following an incorrect response, E1 said, "Well, really, I was just kidding or joking. I knew that she could see the tiny dog, so I was just kidding when I said it was really enormous!"

The four stories were then presented. For each story, five test questions were asked. The questions are discussed using the story presented in the Appendix.

Perceptual access question. "Does the grandfather see that Frank did not clean up his dishes?" This question was asked to ensure that participants understood that the adult in the story had perceptual access to the actual state of affairs. Understanding that a character has perceptual access to relevant story facts is critical for making inferences about that character's knowledge state. Corrective feedback was given to participants who answered this question incorrectly.

First-order knowledge question. "Does Frank know that his grandfather saw the dirty dishes?" The purpose of this question was to explore participants' understanding of the main character's (Frank) first-order mental state. The correct answer was "no" for the lie stories and "yes" for the joke stories. To succeed on this question, participants had to override their own knowledge of the truth (i.e., that the grandfather did see the dirty dishes) and report on Frank's knowledge.

Second-order knowledge question. "Does Frank know that his grandfather knows he did not clean up the dishes?" The purpose of this question was to explore participants' understanding of Frank's second-order knowledge state. It required participants to comment on what one character knew about the other character's knowledge state. As in the previous question, the correct answer was no for the lie stories and yes for the joke stories.

Lie/joke question. At the conclusion of each story, participants were asked to classify the final utterance, which was presented with neutral intonation, as follows: "Was Frank lying or just kidding." The presentation order of the response choices was counterbalanced both within and across participants. We asked this question to determine whether participants could judge the difference between the two forms of literally false statements.

Justification question. "How can you tell that Frank was_____(lying or just kidding)?" Following the lie/joke question, we asked participants to explain their responses.

The four stories were presented in counterbalanced order across participants and each was accompanied by four colored drawings depicting the main characters and story events. Story root by ending (lie vs. ironic joke) was counterbalanced such that each story root appeared an equal number of times as a lie and as a joke. Participants were tested individually by two experimenters. Responses were audiotaped and later transcribed and checked by a second coder.

Response Coding

Responses to the test questions were coded as correct or incorrect. Responses to the justification question were coded into the following categories:

- *Explicit second-order reasoning*: The participant explicitly refers to the knowledge states of both story characters. For example, "Because he doesn't know that his grandfather knows he didn't clean up the dishes."
- *Perceptual information*: The participant refers to the perceptual access of the story character. For example, "Because his grandfather saw that she didn't clean up the dishes."
- *Reality response*: The participant refers to the actual state of affairs. For example, "Because he didn't clean up the dishes."
- *Story facts*: The participant states accurate but irrelevant story facts. For example, "Because he wanted to play with his friends."
- *Reiteration of response*: The participant simply repeats his or her response. For example, "Because he was not telling the truth. Because he was just lying/joking."
- *Other*: No response, or a nonsensical response.

RESULTS

Preliminary analyses revealed that there were no gender differences on any of the test questions. Table 2 shows the means (and standard deviations) for each group on the test questions. A series of one-way ANOVAs, carried out to test for differences among the groups on each of the test questions, revealed that there were no significant group differences on any of the questions. A second set of analyses using Full-Scale IQ as a covariate also revealed no significant group differences on any of the test questions.

We also analyzed the number of participants passing each of the test questions; the data are presented in Table 3. For this analysis, passing consisted of scoring correctly on at least three of four trials for the perceptual-access, first-order and second-order questions. For the lie/joke question there were two questions for which the correct answer was lie, and two for which the correct answer was just kidding. We used two different criteria for this question. The first considered success as the ability to discriminate between lies and jokes, judging this across two pairs of lie/joke stories. Thus, on this criterion, passing the lie/joke discrimination question was defined as answering correctly on all the stories. Passing the lie stories only and the joke stories only was defined as scoring correctly on both trials of these stories.

As shown in Table 3, almost all the participants in the three groups passed the perceptual access question, showing that they understood that the adult character had perceptual access to the story facts. On the first-order knowledge question a majority adolescents in all groups passed at least three of four trials, showing that

TABLE 2
Mean Scores and Standard Deviations on Test Questions

	Williams Syndrome		*Prader–Willi Syndrome*		*Nonspecific Mental Retardation*	
	M	*SD*	*M*	*SD*	*M*	*SD*
Perceptual access	3.44	1.36	3.91	0.30	3.83	0.39
First-order knowledge	2.81	0.98	3.09	1.04	3.17	1.27
Second-order knowledge	2.63	0.96	3.18	1.17	2.75	1.06
Total lie/joke score	2.13	0.34	2.36	0.81	2.42	0.90

Note. Maximum score for all questions = 4.

TABLE 3
Number and Percentage of Participants Passing Test Questions

	Williams Syndrome[a]		*Prader–Willi Syndrome*[b]		*Nonspecific Mental Retardation*[c]	
	Number	*%*	*Number*	*%*	*Number*	*%*
Perceptual access[d]	14	88	11	100	12	100
First-order knowledge[d]	9	56	8	73	8	67
Second-order knowledge[d]	7	44	7	64	8	67
Pass lie/joke[e]	0		2	18	2	17
Pass lie question[f]	14	88	11	100	10	83
Pass joke question[f]	0		2	18	2	17

[a]$n = 16$. [b]$n = 11$. [c]$n = 12$. [d]Passing at least three of four trials. [e]Passing both story pairs. [f]Passing two of two trials.

they were able to override their own knowledge of the story facts and correctly report the knowledge state of the main character. Overall, participants did somewhat less well on the second-order knowledge question. Although a majority of PWS and MRU adolescents passed at least three of four trials of this question (64% and 67%, respectively), only 44% of the WS adolescents passed. Chi-square analyses revealed that this difference was not significant. Adolescents in all three groups performed extremely poorly on the lie/joke discrimination question. Whereas 18% of the PWS and 17% of the MRU were able to correctly distinguish the lies from the jokes, none of the WS adolescents were able to do so, although this difference was not significant.

Looking at performance on the lie and the joke questions separately helps to clarify adolescents' difficulty in distinguishing these two forms of nonliteral utterance. As can be seen in Table 3, nearly all of the adolescents across all groups passed both trials of the lie question. That is, they correctly classified the lies as lies. However, only 2 of the PWS, 2 of the MRU, and none of the WS groups were able to correctly classify both of the joke statements. Of these adolescents, 14 (88%) of the WS, 10 (91%) of the PWS, and 11 (92%) of the MRU groups misclassified the jokes as lies. In contrast, none of the adolescents in any group misclassified the lies as jokes. To summarize, almost all the participants in this study judged all nonliteral statements as lies.

Correlations were computed for each group between performance on the second-order knowledge question, the lie/joke discrimination, and chronological age, Full-Scale IQ, PPVT–R mental age, and PPVT–R standard score. For the WS group, none of these correlations was significant. For the PWS group, performance on the second-order knowledge question was significantly correlated with PPVT–R mental age, $r(11) = .62$, $p < .04$. For the MRU group, performance on the lie/joke discrimination question was significantly correlated with Full-Scale IQ, $r(12) = .63$, $p < .03$. However, because our sample is quite small, the results of these analyses would need to be replicated on a much larger sample of children to determine the reliability of the relations found.

Justifications

The frequencies of different responses to the justification question are presented in Table 4. There were no differences between the lie and the joke stories in the use of the various justification responses. As can be seen, for both the lie and the joke stories, the majority of the justifications either referred to reality or to explicit second-order reasoning. Adolescents in the PWS and the MRU groups gave significantly more explicit second-order justifications than did WS adolescents: $\chi^2(1) = 5.07$, $p < .02$, and $\chi^2(1) = 9.28$, $p < .002$, for the lie stories, and $\chi^2(1) = 5.40$, $p < .02$, and $\chi^2(1) = 6.39$, $p < .01$, for the joke stories,

TABLE 4
Frequency of Justification Responses to the Lie/Joke Test Questions

	Williams Syndrome	*Prader–Willi Syndrome*	*Nonspecific Mental Retardation*
Lie stories			
Explicit second-order	1 (3.1%)	5 (22.7%)	8 (33.3%)
Perceptual information	2 (6.3%)	2 (9.1%)	2 (8.3%)
Reality response	18 (56.3%)	13 (59.1%)	10 (41.7%)
Story facts	4 (12.5%)	2 (9.1%)	2 (8.3%)
Reiteration of response	3 (9.4%)	0 (0.0%)	0 (0.0%)
Other	4 (12.5%)	0 (0.0%)	2 (8.3%)
Joke stories			
Explicit second-order	1 (3.1%)	5 (23.8%)	6 (25.0%)
Perceptual information	5 (15.6%)	3 (14.3%)	4 (16.7%)
Reality response	21 (65.6%)	11 (52.4%)	8 (33.3%)
Story facts	0 (0.0%)	2 (9.5%)	2 (8.3%)
Reiteration of response	0 (0.0%)	0 (0.0%)	0 (0.0%)
Other	5 (15.6%)	0 (0.0%)	4 (16.7%)

respectively. For the joke stories only, the WS adolescents provided significantly more reality justifications than did PWS and MRU adolescents: $\chi^2(1) = 8.87$, $p < .002$, and $\chi^2(1) = 9.52$, $p < .003$, respectively. This suggests that despite the lack of group differences on the lie/joke discrimination question, on the joke stories the adolescents with PWS and MRU were more likely to focus on the mental states of the story characters, whereas the adolescents with WS were more likely to justify their lie/joke decisions by judging the statement against what really happened.

Contingency Between Second-Order Knowledge and Lie/Joke Test Question

Because the ability to distinguish between lies and jokes rests on the ability to conceptualize second-order knowledge states (i.e., what the speaker knows about what the listener knows), we would expect to find a relationship between these two abilities (Sullivan et al., 1995). To test this hypothesis, we looked at the contingency between performance on the lie/joke discrimination and the second-order knowledge questions. Table 5 shows the contingency between passing the second-order knowledge questions and the lie/joke questions, where *passing* was defined as scoring correct on at least three trials of the second-order question and passing at least three of the lie/joke test questions. As can be seen, in all three groups, adolescents were more likely to pass the second-order knowledge question and fail

TABLE 5
Contingency Between Passing Lie/Joke and Second-Order Questions

Group	*Pass Both*	*Pass Lie/Joke Only*	*Pass Second-Order Only*	*Fail Both*
Williams syndrome	0	0	7 (44%)	9 (56%)
Prader–Willi syndrome	2 (18%)	0	4 (36%)	4 (36%)
Non-specific mental retardation	2 (17%)	0	6 (50%)	4 (33%)

the lie/joke discrimination than the reverse: McNemar's test, WS: $\chi^2(1) = 5.15$, $p < .02$, PWS: $\chi^2(1) = 2.25$, $p < .15$; and MRU: $\chi^2(1) = 4.16$, $p < .05$.

Finally, to see to what extent adolescents who can conceptualize second-order knowledge states go on to use this knowledge in their explanations of other's behavior, we looked at the number of justifications that included explicit references to complex mental states following correct responses on the second-order knowledge question. Both the PWS (38%) and the MRU (45%) adolescents provided significantly more explicit references to complex mental states in their justifications than did the WS adolescents (5%): $\chi^2(1) = 12.54$, $p < .001$, and $\chi^2(1) = 15.67$, $p < .001$, respectively. This suggests that even those WS participants who were able to conceptualize second-order knowledge states were not as likely to use that information in their justifications as adolescents in the other two groups.

DISCUSSION

The results of this study demonstrate that adolescents with WS have great difficulty distinguishing lies from jokes. Despite anecdotal reports of good language skills, particularly with conversational discourse, and their intense social investment in others, the WS adolescents in this study were no better at telling the lies from the jokes than matched comparison groups of PWS and mentally retarded adolescents. Thus, the assumption that there is a link among good language, social interest, and theory of mind is erroneous. None of the WS adolescents and only two adolescents in each of the PWS and mentally retarded groups could correctly identify both pairs of lie/joke stories. Nearly all the participants in the three groups misclassified the jokes as lies (88% WS, 91% PWS, and 92% MRU), whereas none of the adolescents in any group misclassified the lies as jokes. This error pattern mirrors what has been found in much younger normally developing children (Sullivan et al., 1995). Given that we know that normally developing children are able to distinguish between lies and other forms of intentional falsehood by middle childhood (Andrews et al., 1988; Leekam, 1991; Winner et al., 1987),

the strikingly poor performance of the developmentally disordered adolescents in this study suggests serious impairment in this critical social–cognitive ability in these populations.

Adolescents in all three groups were much more successful at attributing perceptual access and first- and second-order knowledge states. Nearly all participants in all three groups understood the story characters' access to relevant perceptual information, and the majority of participants were also able to correctly report the main characters' first-order knowledge states. Thus, in the lie stories, participants were able to override their own knowledge of the story facts and correctly report on the main character's inaccurate knowledge of the truth. On the more complex second-order knowledge question, a majority of PWS and MRU adolescents and nearly half of the WS adolescents were able to attribute second-order knowledge states on at least three of four trials. Although many of the participants in all three groups had the prerequisite underlying knowledge of the characters' complex mental states, the vast majority was unable to tell lies from jokes.

These findings demonstrate that for adolescents with a variety of developmental disorders, the ability to distinguish lies from jokes depends in part on the prerequisite ability to attribute second-order mental states, specifically second-order knowledge. Adolescents in the three disordered groups were all more likely to pass the second-order knowledge question and fail the lie/joke discrimination than the reverse. Again, this is consistent with findings in the developmental literature (Happé, 1993; Leekam, 1991; Sullivan et al., 1995; Winner & Leekam, 1991). At the same time, it is important to note that among normally developing children there is a strong connection between the acquisition of second-order mental state knowledge and the ability to distinguish lies and other forms of nonliteral language; the timing between these developments is within a couple of years.

In contrast, among the developmentally disordered populations, although more than half passed the second-order knowledge questions, only 10% successfully discriminated between the lies and the jokes. Furthermore, many of the adolescents justified their responses by comparing the false statement to reality, rather than considering the second-order knowledge of the speaker. This is a strikingly immature response, suggesting that many adolescents had considerable difficulty integrating their understanding of other minds with their interpretation of speakers' nonliteral utterances. Further, whereas a substantial proportion of PWS and MRU participants who evidenced an understanding of second-order knowledge states referred to those states in their justifications, only 5% of the participants with WS did so. This suggests that adolescents with WS may have particular difficulty grasping the underlying connection between mental states and nonliteral language. Overall, the connection between acquiring a theory of mind and nonliteral language may not be as close in disordered populations as it is in normally developing children. However, longitudinal data would be needed to distinguish

whether the gap is greater for children with mental retardation than for children who are developing normally.

The findings reported here on adolescents with WS contrast with those reported by Karmiloff-Smith et al. (1995), who found that 50% of WS participants were able to interpret sarcastic statements, which, like lie/joke discrimination, require an understanding of higher order mental states. One possible explanation for this discrepancy may be in the way in which the stimuli were presented. In our study, the critical lie/joke statement was purposefully delivered in neutral prosody to rule out the possibility that participants could discriminate the lies and jokes on the basis of prosodic features alone. The sarcastic statements in the Karmiloff-Smith et al. study may have been presented with natural prosody; the description of the methods used in their study does not preclude this possibility. If prosodic cues were provided, this could have allowed the WS participants to ignore the speaker's stated attitude to an internally represented thought (higher order understanding) and solve the task by interpreting the social–affective meaning of the statement via the prosodic features of the utterance. Although no studies have directly investigated whether people with WS are good at interpreting the social–affective aspects of prosody, their natural expressiveness in both conversational and narrative discourse contexts suggests that this may be the case (Reilly et al., 1990).

Recently we proposed that in WS, there is an important distinction in theory of mind abilities between a social perception component and a social cognitive component (Tager-Flusberg & Sullivan, 2000). The social perceptual component, which we argue is relatively spared in WS, refers to the capacity to make online immediate judgments of mental states on the basis of perceptual information available in facial expressions, vocal prosody, or body gesture. In contrast, the social cognitive component of theory of mind, which is not spared in WS, encompasses more complex cognitive reasoning about the mind, as tapped in more classic theory of mind tasks, such as false belief. Thus, on this view, adolescents with WS might be particularly adept at using prosodic cues to distinguish lies and jokes because this would draw on their relatively spared social perceptual component of theory of mind. On the other hand, this model of theory of mind fits with our findings that adolescents with WS would not perform well on tasks that entailed complex cognitive reasoning required for distinguishing between lies and jokes solely on the basis of information in the stories, which was required in the task we presented.

Despite the relatively good performance of all three groups on the theory of mind test questions, none of the groups performed well on the lie/joke discrimination. What is the social relevance of this poor performance? The inability to distinguish between intentionally false utterances intended as jokes versus those intended to deceive would seriously impair one's ability to relate to others in everyday social situations. Not being able to tell, for example, when someone is making a joke at your expense (e.g., "I just love your new haircut") or always

being in the dark about a deceptive plan meant to hurt you would lead to severe problems with peers. It is not hard to imagine why children with developmental disabilities often find themselves the objects of teasing and cruel jokes by other children (Guralnick, 1984; Kasari & Bauminger, 1998). Simply keeping up with everyday discourse on the playground, which is littered with lies, jokes, ironic statements, and sarcastic remarks, would be an overwhelming if not impossible task for many of these children. Difficulties with peers would be the inevitable outcome of this sort of communicative incompetence. Indeed, we know that despite their social interest, people with WS have great difficulty forming and maintaining peer relationships throughout childhood (Davies, Udwin, & Howlin, 1998; Einfield, Tonge, & Florio, 1997; Udwin & Yule, 1991). Interestingly, children and adolescents with WS often have very positive relationships with adults, which do not seem to be affected by their lack of understanding of the differences between literal and nonliteral language. One possible explanation is that adults are more understanding of the limitations of individuals with WS and other developmental disorders, and simply do not use these types of intended falsehoods or other forms of nonliteral language in their conversations with these individuals.

Finally, the results of this study also provide some interesting evidence that neurodevelopmental disorders are fundamentally different from acquired disorders in adulthood. (Karmiloff-Smith, 1997; Paterson, Brown, Gsodl, Johnson, & Karmiloff-Smith, 1999). The participants in this study who were unable to discriminate between lies and ironic jokes all made the same kind of error: They systematically called all the jokes lies, and many of their justifications were comparisons between what was said with the reality. Thus the adolescents with WS, PWS, and MRU who failed the task considered nonliteral utterances to be lies, without reference to the speaker's mental state. This error pattern is similar to what has been reported among normally developing children (Sullivan et al., 1995; Winner & Sullivan, 1999). In contrast, Winner et al. (1998) found that adults with RHD had a very different error pattern, confusing lies and jokes. In their study, the adults with RHD were as likely to say that lies were jokes as they were to say that jokes were lies (the typical pattern.) Thus, whereas normally children and the atypical children in the present study have a default strategy to take nonliteral utterances as lies, the individuals with RHD do not. Winner et al. attribute the RHD adults' difficulty with nonliteral language to acquired impairments in higher order theory of mind. Because the patients in their study had once been capable of distinguishing among different types of falsehood, they were more likely to mix up the different nonliteral forms rather than resort to a developmentally primitive strategy (Brownell, Griffin, Winner, Friedman, & Happé, 2000; Winner & Sullivan, 1999). Thus, individuals with neurodevelopmental disorders, including those with WS, process nonliteral language in quite different ways from adults with acquired brain damage. We cannot take the parallel difficulties both groups have with distinguishing between lies and jokes as evidence that people with WS

have a form of right hemisphere damage. Clearly the source of their difficulties lies elsewhere, and it is too simplistic and theoretically naive to equate the neuropsychological deficits associated with acquired RHD and WS, or even other neurodevelopmental disorders. Future research may provide insights into the underlying neurocognitive mechanisms that can explain why individuals with neurodevelopmental disorders, including WS, have such difficulty interpreting speakers' intended meaning in nonliteral discourse.

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APPENDIX
Script for Lie/Joke Task

Lie Version

This is a story about a boy named Frank and his grandfather. They are in the living room. Frank really wants to go to the mall with his friends, but his grandpa says he must first clean up his dishes. Frank hates cleaning up.

Grandpa goes out of the room to make a phone call. Frank does not clean up his dishes. See the dishes on the table? Now Frank goes into his room. While he is gone, Grandpa comes back into the living room and looks at the table covered with dishes. Frank does not see Grandpa looking at the dishes because he is in his room.

Perceptual access question. Does Grandpa see that Frank did not clean up his dishes? (If correct: That's right! Grandpa is looking right at the table covered with dishes; If incorrect: But look, Grandpa is looking right at the table covered with dishes.)

First-order knowledge question. Does Frank know that Grandpa saw the dirty dishes? Grandpa says to himself, "Frank did not clean up the dishes!"

Second-order knowledge question. Does Frank know that Grandpa knows that he did not clean up the dishes?

Now, Grandpa goes to Frank's room. Frank says to Grandpa, "I did a really good job cleaning up my dishes!" Now remember, Frank does not know that Grandpa saw the dishes on the table.

Lie/Joke discrimination question. Was Frank just kidding or lying (lying or kidding)?

Justification. How can you tell that Frank was (lying/just kidding)?

Joke Version

This is a story about a boy named Frank and his grandfather. They are in the living room. Frank really wants to go to the mall with his friends, but his grandpa says he must first clean up his dishes. Frank hates cleaning up.

Grandpa goes out of the room to make a phone call. Frank does not clean up his dishes. See the dishes on the table? Now Grandpa comes back. He looks right at the table covered with dishes.

Perceptual access question. Does Grandpa see that Frank did not clean up his dishes? (If correct: That's right! Grandpa is looking right at the table covered with dishes; If incorrect: But look, Grandpa is looking right at the table covered with dishes.)

First-order knowledge question. Does Frank know that Grandpa saw the dirty dishes? Grandpa says to himself, "Frank did not clean up the dishes!"

Second-order knowledge question. Does Frank know that Grandpa knows that he did not clean up the dishes?

Frank says to Grandpa, "I did a really good job cleaning up my dishes!" Now remember, Frank knows that Grandpa saw the dirty dishes.

Lie/joke discrimination uestion. Was Frank just kidding or lying (lying or kidding)?

Justification. How can you tell that Frank was (lying/joking)?