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Trust and social reciprocity in adolescence – A matter of perspective-taking

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A B S T R A C T

Changes in social behaviour from childhood to adulthood have been suggested to be driven by an increased sensitivity to others' perspectives. Yet, the link between perspective-taking and social processes, such as trust and reciprocity, has rarely been investigated during adolescence. Using two trust games with a cooperative and an unfair counterpart and an online perspective-taking task with 50 adolescents, we show that those with a higher perspective-taking tendency demonstrate greater trust towards others and higher levels of trust during cooperative interactions. Both low and high perspective-takers adapted their levels of trust in response to unfair behaviour. However, high perspective-takers reduced their trust more drastically and showed more malevolent and less benevolent tit-for-tat when they were treated unfairly by their counterpart. The findings suggest that a higher perspective-taking tendency in adolescence is associated with specific mechanisms of trust and reciprocity, as opposed to undifferentiated increases in positive social behaviour towards others.

Introduction

The propensity to take another person's point of view into account (i.e. perspective-taking) has been regarded as an essential process in the social cognitive system (Burns, 2006; Frith & Frith, 2001) and is an important determinant of successful daily-life social functioning (Fett et al., 2011). Fundamental aspects of perspective-taking emerge during childhood, (Barresi & Moore, 1996; Leslie, 1987; Perner & Davies, 1991) and the development from pre-reflective to more complex and meta-reflective levels of perspective-taking has been suggested to underlie age-related increases in pro-social behaviour towards others (Eisenberg, Cumberland, Guthrie, Murphy, & Shepard, 2005; Galinsky, Ku, & Wang, 2005; Martin, Sokol, & Elfers, 2008). Support for this notion comes from early work by Johnson (1975) who investigated social perspective-taking

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and the tendency for cooperation in children between 9 and 11 years of age. The results showed that high cooperators were more skilled at considering others' emotional perspectives (Johnson, 1975). The link between higher perspective-taking skills and more advanced social behaviour has also been supported by research in children with autism between the ages of 6 and 14 (Dawson & Fernald, 1987) and in adult university students, in whom better perspective-taking was associated with more success in strategic social interactions (Galinsky, Maddux, Gilin, & White, 2008). A series of experimental studies by Epley, Caruso, and Bazerman (2006) further specified the association between perspective-taking and social behaviour in adult university students. In line with the previously described studies, the ability to consider another person's perspective was associated with a diminished egocentric assessment of fairness in a social dilemma. However, this reduction in egocentric assessment of fairness did not lead to reduced egocentric behaviour throughout social contexts; apparently, in adults the ability to abandon the egocentric viewpoint in order to consider others' perspectives does not necessarily imply an analogous change in behaviour. Furthermore, the competitive or cooperative nature of the social interaction was an important moderator of the impact of perspective-taking on social behaviour in adults (Epley et al., 2006). In cooperative interactions perspective-taking reduced egocentric behaviour, whereas in competitive circumstances perspective-taking appeared to highlight self-interested motives. These findings suggest a potentially changing and complex association between the increasing tendency to take others' perspectives into account and social behaviour, which may change from childhood to adulthood.

Although the development of perspective-taking and its relationship with social behaviour has long been an area of interest, little work has investigated the association between perspective-taking and social behaviour in adolescence (Dumontheil, Apperly, & Blakemore, 2010; Ensink & Mayes, 2010; Hughes, 2004). During adolescence, young people frequently encounter situations of increasing social demand that require new behavioural and cognitive strategies (Blakemore & Choudhury, 2006; Dumontheil, Apperly, et al., 2010). In line with the assumption that pro-social behaviour increases with age and with the increasing tendency to consider others' viewpoints, experimental studies confirm age-related changes in social behaviour beyond childhood, such as increases in trust and reciprocity during social interactions (Belli, Rogers, & Lau, 2012; Fett, Gromann, Giampietro, Shergill, & Krabbendam, 2012; Van den Bos, Westenberg, Van Dijk, & Crone, 2010). Recent research also suggests an increase in the usage of perspective-taking during late adolescence (Dumontheil, Apperly, et al., 2010). However, the previously discussed research on perspective-taking and social behaviour in children and adults suggests that the association between the two concepts may not be as straightforward as it seems (Epley et al., 2006; Johnson, 1975).

Measuring social cognition 'online'

To date, most studies on social cognition and behaviour in adolescence have employed 'off-line' measures, such as questions about stories or cartoon characters (Adolphs, 2006). These approaches have yielded valuable insights into perspective-taking, but were unable to capture its dynamic and interactive aspect. There is now an increasing acknowledgement of the importance of the participatory aspects of social cognition during social interaction (De Jaegher, Di Paolo, & Gallagher, 2010). Perspective-taking has been studied using an online communication paradigm in which participants have to use their conceptual competence for mentalising to take another person's perspective into account (Dumontheil, Apperly, et al., 2010; Dumontheil, Küster, Apperly, & Blakemore, 2010; Korver-Nieberg et al., 2013). In this paradigm participants see a 4×4 set of shelves consisting of slots that contain different objects. Most of these objects are visible to the participant and a person standing on the other side of the shelves. However, some objects are only visible to the participant. The person on the other side of the shelves (the 'director') instructs the participant to move certain objects to different slots. In order to select the correct objects, participants have to consider the director's perspective, rather than using their own egocentric viewpoint, which seems to be the default in human judgement (Epley & Caruso, 2004).

Another line of research has employed exchange paradigms from game theory, such as the trust game, for the online investigation of social mechanisms that cannot be captured with questionnaires or observation (Belli et al., 2012; Evans & Krueger, 2011; Van den Bos, Van Dijk, Westenberg, Rombout, & Crone, 2011; Van den Bos et al., 2010). In the trust game the first player (the investor) is given an initial endowment from the experimenter (Berg, Dickhaut, & McCabe, 1995). The investor can share any part of that amount with the second player (the trustee). The shared amount is multiplied and after having received the money, the trustee decides whether to honour the investor's trust (i.e. send part of the money back) or whether to behave in an untrustworthy manner (i.e. keep all or most of it). For the trustee, the highest earnings are obtained by keeping the money. Thus, sharing money in the first place requires the investor to trust in the benevolence of the trustee. Also, a higher initially shared amount signals pro-social intentions towards the trustee. The financial repayment of the trustee is a proxy of trustworthiness. Decision-making in repeated trust games requires perspective-taking skills of varying complexity. On the one hand, it is important to predict the moves and intentions of the game partner; on the other hand, it is also crucial to understand how the game partner perceives and interprets one's own moves. Initial evidence for an important role of perspective-taking within adolescent social interactions in the context of social behaviour comes from a trust game study by Van den Bos et al. (2011), who studied young people between 12 and 22 years in the role of the trustee. Interestingly, there were no age-related changes in reciprocity towards the investor. However, with increasing age, adolescents became increasingly sensitive to the perspective of the investor, as indicated by an increased reciprocity when the investor took a higher risk during trusting decisions.

The current study

The aim of the current study was to investigate the link between the ability to conceptualize the others' perspectives and social behaviour in adolescence. We used an online perspective-taking task and a trust game to investigate the relationship between the tendency to consider others' viewpoints and the social processes of trust and reciprocity in adolescents aged 13–18 years. Specifically, we examined the association between perspective-taking and i) basic trust towards an anonymous person, i.e. the value of the initial investment in the trust game; ii) the change in trust (i.e. investments) over the course of 20 consecutive social interactions with two different game partners; and iii) reciprocity (i.e. the tendency to return the trustee's degree of trustworthiness tit-for-tat). Perspective-taking tendency was assessed with the 'perspective-taking task' (Dumontheil, Apperly, et al., 2010; Dumontheil, Küster, et al., 2010; Keysar & Barr, 2000). Previous research indicated that the effects of perspective-taking on social behaviour are moderated by the cooperative or uncooperative nature of the social interaction (Caruso, Epley, & Bazerman, 2006). Therefore, trust and reciprocity were assessed with two multi-round trust games that were played with (hypothetical) partners whose trustworthiness was pre-programmed to be either cooperative or unfair. We hypothesized that high perspective-takers, i.e. those with a strong tendency to consider others' viewpoints, would be better at recognizing and predicting the intentions of their counterpart than would low perspective-takers (i.e. those with a weak tendency to consider others' viewpoints in the perspective-taking task). We also expected higher basic trust in those with a stronger tendency to consider others' viewpoints, because of an increased awareness that the interaction partner is likely to perceive higher initial investments as a signal of their willingness to cooperate. In addition, we expected more trust and benevolent behaviour during interactions with a cooperative counterpart, and less trust and less benevolent behaviour during interactions with an unfair counterpart in high perspective-takers. We examined the effects of age, gender and estimated cognitive ability on perspective-taking and the expression of trust and reciprocity towards others in all analyses.

Method

Participants

The sample consisted of 50 adolescents (25 males and 25 females) between 13 and 18 years (mean = 16.07; SD = 1.57; girls and boys did not differ significantly in age ($p = 0.34$)). The experiment was carried out in London, UK, and participants had a very good command of the English language. Specifically, 54% were of White-British origin, 35% of Black-British origin, 2% of Asian-British origin and 9% indicated a different ethnicity. The vocabulary subtest of the Wechsler Abbreviated Scale of Intelligence (WASI; (Wechsler, 1999)) was used as indicator of cognitive ability (T-score mean = 51.52; SD = 11.80; girls and boys did not differ significantly in estimated cognitive ability ($p = 0.24$)). Participants were recruited from both state and private secondary schools in the local area, by asking adult research volunteers in the Institute of Psychiatry volunteer database 'Mindsearch' to invite their children to take part, via colleagues and via previous participants. Forty-seven participants lived with their parents, one lived alone and two did not indicate their living status. None of the participants were familiar with the tasks that were employed in the current study. Informed consent was obtained from all adolescents and from their parents/guardians if the adolescents were under the age of 16. The study was approved by the South West London Research Ethics Committee.

Design and stimulus material

Perspective-taking task. The perspective-taking task is a computer simulation by Dumontheil, Apperly, et al. (2010) and Dumontheil, Küster, et al. (2010) and based on the Keysar task (Keysar & Barr, 2000). Stimuli consist of 16 slot shelves that contained eight different objects. The task has two conditions; 1) Director condition: a director standing behind the shelves instructs the participant to move certain objects into different slots. Five slots are visible to the participant, but occluded from the director's view (Fig. 1). In experimental trials, the correct response is to select the best fitting object that is also visible to the director and to ignore a distracting object, which also fulfils the director's instruction but is invisible to him (Fig. 1a). Objects are arranged identically in the control trials, but an irrelevant object replaces the distracting object (Fig. 1b). Instructions in filler trials refer to objects that are visible to the director and the participant. 2) No-Director condition: participants have to move objects while following the rule of ignoring those in slots with a grey background. The order of trial types (control ($n = 8$); experimental ($n = 8$); filler ($n = 48$)) was counterbalanced. See Dumontheil, Apperly, et al. (2010) and Dumontheil, Küster, et al. (2010) for a more detailed description of the perspective-taking task (Dumontheil, Apperly, et al., 2010).

The trust game. All participants played two trust games, each consisting of 20 game rounds. They were told that they were playing with two anonymous human counterparts. However, in reality two probabilistic computer algorithms were used to model the counterparts, one reflecting a cooperative and one reflecting an unfair decision-making style. In the cooperative strategy, the first repayment was 100%, 150% or 200% of the invested amount. Each possible first repayment occurred with a probability of 33%. Subsequent repayments increased in a probabilistic way if the current investment increased relative to the previous investment, but remained stable otherwise. Hence, with each increase in investor trust, the chance of a repayment of 200% increased by 10%. Reactivity to negative social feedback was studied in the unfair condition. In the unfair algorithm, the first repayment was 50%, 75% or 100% of the investment. Each possible first repayment occurred with a probability of 33%.

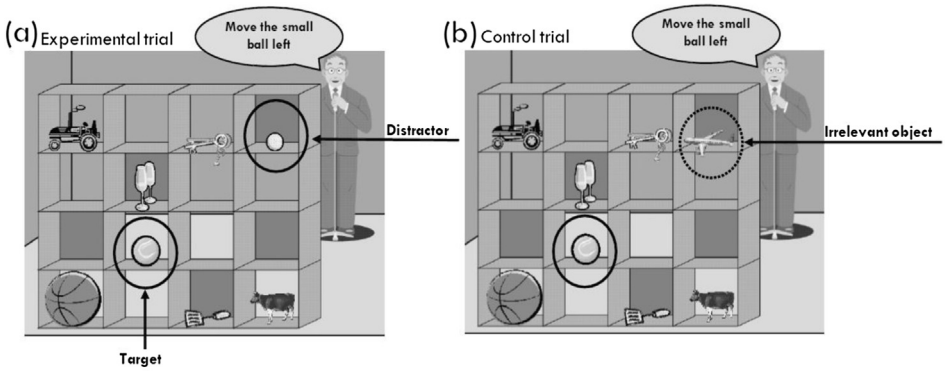

Fig. 1. Example of an Experimental (a) and a Control trial (b) in the Director condition. *Note*. The participant heard the instruction: 'Move the small ball left' from the director. Experimental trial (a): if the participant ignored the director's perspective he would move the distractor ball (golf ball, cannot be seen by the director), which is the smallest ball in the shelves instead of the larger target ball (tennis ball) that is visible from the participant's and the director's perspective. In the Control trial (b), an irrelevant object (plane) replaces the distractor item.

Subsequent repayments decreased if the current investment reflected an increase in trust relative to the previous investment, but remained stable otherwise. Hence, with each increase in investor trust, the chance of a repayment that was 50% of the investment increased by 10%. Participants took the role of investor throughout both games. In each game round they had to transfer an (integer) amount between £0 and £10 to the trustee. The transferred amount was tripled. The subsequent trustee repayment depended on the previous investments of the investor and on the computer algorithm. The order of games (cooperative/unfair) was counterbalanced between subjects.

Procedure

Participants were tested individually. Standardized instructions of the perspective-taking task were given and an example stimulus of each condition was shown. It was explained to the participants that the director would tell them which object to move, where to move the object and that the director had a different perspective from theirs. The director's perspective was illustrated with an image of his view of the shelves. To check whether participants understood what was required from them, they were asked to indicate objects that the director could and could not see. The perspective-taking task started once participants answered correctly. There were four practice trials before the Director condition. New instructions and an example stimulus were provided before the No-Director condition. Again, participants had to demonstrate what was required of them. Everyone completed the Director condition first to prevent them from applying the strategy provided for the No-Director condition. Subsequently, participants were assessed on the WASI vocabulary subtest. They then took part in the trust games. They were given detailed written information about the procedure and two trust game rounds were illustrated by means of graphic examples. The experimenter explained the game to the participants and asked comprehension questions to ensure that they fully understood how the game worked. Participants were told that their game partners were in a different location and that they would interact via internet. At the end of the testing session, participants completed a questionnaire on their perception of the game. 59% believed that their counterpart was real and 41% indicated that they had some doubts that they were playing a real human player. Whether participants were entirely sure whether they were playing a real human partner or not had no significant impact on investment behaviour in either condition (both $p > 0.24$) or the amount of perspective-taking errors ($p = 0.50$). Finally, the earnings from one round of the trust game were paid out to the participants at the end of the experiment in addition to the participation fee of £10.

Data analysis

The analysis was conducted in STATA 11.0. For the perspective-taking task, the overall number of errors, perspective-taking errors (moving the distracting object that was invisible to the director) and equivalent errors in the No-Director condition (moving the distracting object in a slot with a grey background), were calculated for each participant by condition (Director/No-Director) and trial type (Control/Experimental). To control for multiple observations per participant, multilevel random regression analyses with condition and trial type as predictors were performed for the overall number of errors. Multilevel random regression analyses with condition as predictor were also conducted for perspective-taking errors and their equivalent in the No-Director condition (experimental trials only). To ensure that deviations from normality did not influence the results, analyses were repeated using non-parametric Kruskal–Wallis tests (see Supplementary material). We created a median (median = 3, range 0–8) based two-level variable (low/high perspective-taking tendency) for further analyses with respect to the trust game (see Supplementary material Fig. 1). Participants with high perspective-taking error rates (>3 errors) were considered low perspective-takers; those with low error rates ≤3 were considered high perspective-takers.

Accordingly, 27 participants were classified as low perspective-takers (mean = 5.66, SD = 1.58) and 23 were classified as high perspective-takers (mean = 0.64, SD = 0.63).

For the trust game we analyzed: i) the effect of condition (cooperative/unfair) on the investments; ii) the associations between perspective-taking tendency (as indicated by the perspective-taking task) and the first investments in the trust games (basic trust); iii) the associations between perspective-taking tendency and the development of investments across game rounds within each trust game; and iv) the associations between perspective-taking tendency and changes in investments between game rounds within the two trust games, indicating benevolent, malevolent or neutral reciprocity towards the counterpart independent of the height of the investments. For a simplified investigation of changes in trust over the course of the two trust games (iii) we divided each game into four blocks of five game rounds. To explore reciprocity independent of the magnitude of investments (iv), we analyzed the directionality of investment changes from the previous to the current game round. This is important, because the implication of a £5 investment is very different if the previous investment was £1 as compared to £10. Therefore, each investment decision was classified as being in one of three behavioural categories: 1) *benevolent reciprocity*: the investor increased the investment from the preceding to the current round or maintained the highest investment of £10 from one round to another; 2) *malevolent reciprocity*: the investor decreased the investment from the preceding to the current round or maintained the lowest investment of £0 from one round to another or 3) *neutral reciprocity:* all other occasions where the investor did not change the investment between two game rounds. Multilevel random regression analyses were used to account for multiple observations (investments or reciprocity (level 1); within participants (level 2)). The effects of age, gender and estimated cognitive ability on trusting behaviour were examined in all analyses. Effect sizes are expressed as the regression coefficient *b* with its 95% confidence interval.

Results

Perspective-taking task

Table 1 shows means and standard deviations of overall and perspective-taking errors on the perspective-taking task by condition and trial type. There were no significant effects of age, gender or cognitive ability on the number of overall or perspective-taking errors (all $p > 0.27$). Regression analyses showed a significant trial type by condition interaction on the total amount of errors ($b = -2.04$, $p < 0.01$, 95%CI = −2.23/−1.84). Overall, participants made more errors in experimental than in control trials. This effect was stronger in the Director condition ($b = 3.39$, $p < 0.01$, 95%CI = 3.25/3.53) than in the No-Director condition ($b = 1.35$, $p < 0.01$, 95%CI = 1.26/1.44). The number of perspective-taking errors in the Director condition was significantly higher (mean = 3.52, SD = 2.69) than the number of the equivalent errors (moving the object located in the grey background slot) in the No-Director condition (mean = 0.77, SD = 1.47, $b = -2.75$, $p < 0.01$, 95%CI = −2.89/−2.60). Non-parametric Kruskal–Wallis tests yielded identical results for the analyses described above (see Supplementary material). Our results replicate previous findings (Apperly et al., 2009; Dumontheil, Apperly, et al., 2010; Keysar, Lin, & Barr, 2003) and suggest that it is specifically the social perspective-taking component in the Director condition that increases task difficulty.

The trust game

Table 2 shows means and standard deviations of the investments by condition (cooperative/unfair), group (low/high perspective-takers) and block (1–4). The investments were significantly lower in the unfair condition than in the cooperative condition ($b = -2.91$, $p < 0.01$, 95%CI = −3.14/−2.68), showing that participants perceived the two counterparts as behaving differently. Significant interactions were present between the three potentially confounding variables age, gender and cognitive ability and condition (all $p < 0.01$). Analyses per trust game condition (cooperative/unfair) showed no significant effects of age, gender and cognitive ability on investments within the two conditions, with the exception of one significant positive association between estimated cognitive ability and investments in the cooperative condition ($b = 0.06$, $p < 0.05$, 95% CI = 0.01/0.10).

Table 1
The perspective-taking task: errors by condition and trial type.

Trial type	Condition	
	Director	No-Director
	M (SD)	*M* (SD)
Experimental		
Overall errors	4.03 (2.72)	1.75 (2.12)
PT errors	3.52 (2.69)	0.77 (1.46)
Control		
Overall errors	0.64 (1.06)	0.39 (0.474)

Note. PT = Perspective-taking.

Table 2
Means and standard deviations of investments by perspective-taking group, block and condition.

Condition		Block 1	Block 2	Block 3	Block 4
		Investment £	Investment £	Investment £	Investment £
		M (SD)	*M* (SD)	*M* (SD)	*M* (SD)
Cooperative	Low PT	5.39 (2.72)	5.94 (2.95)	5.75 (4.04)	6.02 (2.92)
	High PT	6.69 (2.68)	6.90 (2.97)	7.52 (2.72)	7.49 (2.47)
Unfair	Low PT	4.12 (2.85)	3.77 (2.79)	3.10 (2.54)	2.58 (2.68)
	High PT	5.32 (2.88)	3.66 (3.18)	3.15 (3.01)	2.41 (2.44)
Cooperative	Overall	5.99 (2.77)	6.38 (2.99)	6.56 (3.03)	6.70 (2.82)
Unfair		4.66 (2.92)	3.72 (2.96)	3.12 (2.76)	2.51 (2.34)

Note. Low PT = low perspective-taking tendency, High PT = high perspective-taking tendency.

Perspective-taking and trust

Basic trust. The initial investments of high perspective-takers were significantly higher (mean = 6.53, SD = 2.19) than those of low perspective-takers (mean = 5.37, SD = 2.52; $b = 1.15$, $p < 0.05$, 95%CI = 0.05/2.24). There were no order effects of condition (cooperative/unfair) on the magnitude of the initial investments ($b = 0.06$, $p = 0.40$, 95%CI = −0.07/0.19). No significant effects of age, gender or cognitive ability on the initial investments were found (all $p > 0.46$).

There was no association between ethnic origin and perspective-taking tendency ($p = 0.25$) or behaviour during the trust game ($p = 0.18$).

The development of trust over game rounds

Main effects of perspective-taking group, block (1–4) and condition (cooperative vs. unfair) were qualified by a three-way interaction ($b = -0.48$, $p < 0.01$, 95%CI = −0.64/−0.32). Analysis of the effects per condition indicated a positive association between block number and investments in the cooperative condition ($b = 0.23$, $p < 0.01$, 95%CI = 0.12/0.34), showing that investments increased significantly over time. The main effect of group was significant, indicating that high perspective-takers made higher investments ($b = 1.17$, $p < 0.05$, 95%CI = 0.08/2.25). The block by group interaction was not significant and dropped from the model ($b = -0.13$, $p = 0.27$, 95%CI = −0.35/0.10). Estimated cognitive ability had a significant impact on investments in the cooperative condition and was therefore controlled for in this analysis.

The main effects of block and group on the investments in the unfair condition were qualified by a significant interaction ($b = 0.40$, $p < 0.01$, 95%CI = 0.12/0.67). With increasing block number, low and high perspective-takers decreased their trust towards an unfair partner. However, this effect was stronger for high perspective-takers ($b = -0.92$, $p < 0.01$, 95%CI = −1.13/−0.71) than for low perspective-takers ($b = -0.53$, $p < 0.01$, 95%CI = −0.70/−0.35, see Table 2).

Perspective-taking and reciprocity

Overall, participants showed significantly less benevolent reciprocity ($b = -15.16$, $p < 0.001$, 95%CI = −21.74/−8.59) and more malevolent reciprocity ($b = 16.92$, $p < 0.001$, 95%CI = 10.82/23.03) towards an unfair than towards a cooperative partner. There was no overall difference in neutral reciprocity during unfair interactions compared to cooperative interactions ($b = -1.75$, $p = 0.47$, 95%CI = −6.55/−1.05). All analyses were controlled for age, gender and estimated cognitive ability.

Cooperative interactions. Regression analyses per condition showed that there was no significant difference between the perspective-taking groups in the percentage of benevolent- ($b = -1.88$, $p = 0.72$, 95%CI = −12.37/8.60), malevolent- ($b = -2.14$, $p = 0.61$, 95%CI = −10.6/6.32) or neutral reciprocity ($b = 4.02$, $p = 0.31$, 95%CI = −3.91/11.97) during cooperation. There was no effect of age, gender or estimated cognitive ability on the percentage of benevolent reciprocity (all $p > 0.19$). Age and gender did not influence the percentage of malevolent- and neutral reciprocity (all $p > 0.190$), but a lower estimated cognitive ability was associated with more malevolent reciprocity ($b = -0.52$, $p < 0.01$, 95%CI = −0.87/−0.16) and marginally significantly less neutral reciprocity ($b = 0.3$, $p = 0.06$, 95%CI = −0.17/0.65) towards a cooperative partner (see Table 3).

Table 3
Means and standard deviations of the percentage of neutral, benevolent and malevolent reciprocity by perspective-taking group and condition.

Condition	Group	Neutral Mean % (SD)	Benevolent Mean % (SD)	Malevolent Mean % (SD)
Cooperative	Low PT	10 (11.12)	55 (14.44)	35 (13.20)
	High PT	14 (15.97)	56 (23.59)	30 (16.95)
Unfair	Low PT	12 (11.82)	44 (12.92)	44 (12.60)
	High PT	8 (10.43)	35 (13.19)	57 (16.71)

Note. Low PT = low perspective-taking tendency, High PT = high perspective-taking tendency.

Unfair interactions. High perspective-takers exhibited significantly less benevolent ($b = -8.29$, $p < 0.05$, 95%CI = −16.35/−0.24) and more malevolent reciprocity ($b = 11.67$, $p < 0.01$, 95%CI = 3.15/20.18) towards an unfair trustee than low perspective-takers. There was no difference between the perspective-taking groups with respect to neutral reciprocity ($b = -3.37$, $p = 0.29$, 95%CI = −9.74/−3.00). There was no effect of age, gender or estimated cognitive ability on benevolent reciprocity (all $p > 0.28$). Age and estimated cognitive ability were not significantly related to the percentage of malevolent and neutral reciprocity (all $p > 0.14$), but male gender was associated with more malevolent ($b = 9.07$, $p < 0.05$, 95%CI = 0.63/17.52) and less neutral reciprocity ($b = -8.21$, $p < 0.05$, 95%CI = −14.53/−1.88; see Table 3).

Discussion

This study used a multi-round trust game and an online perspective-taking task to investigate the relationship between perspective-taking and different aspects of social behaviour in adolescence. Specifically we investigated how perspective-taking is related to (basic) trust, the development of trust across interactions with a cooperative and an unfair other, and social reciprocity (i.e. the tendency to answer behaviour by the game partner tit-for-tat) in adolescents between 13 and 18 years. Previous research in children and adults has frequently associated a higher perspective-taking tendency with more cooperation, but research in adults has also shown that this effect depends on the nature of the social interaction (Epley et al., 2006). The latter suggests a more complex and potentially changing association between an increasing perspective-taking tendency and social behaviour from childhood to adulthood. In line with the Epley et al. (2006) findings, our results demonstrated an association between a high perspective-taking tendency and high (basic) trust and reciprocity towards others. However, these effects depended on the social character (cooperative vs. unfair) of the interaction partner. Specifically, a high perspective-taking tendency, i.e. a lower egocentric bias on the perspective-taking task, was associated with: i) a higher initial expression of trust towards an anonymous other, as indicated by a greater magnitude of initial investments; ii) higher levels of trust in response to positive social behaviour, as indicated by higher investments throughout the cooperative condition; and iii) a stronger reaction to negative social behaviour, as indicated by a steeper decline in both magnitude of investments and a lower proportion of benevolent and more malevolent reciprocity towards an unfair other.

Perspective-taking and trust

The higher degree of basic trust shown by the high perspective-takers suggests that, for adolescents, taking into account another person's perspective (i.e. lower egocentricity) goes hand-in-hand with a more positive approach behaviour towards unknown others, possibly because of an increased awareness of how the first investment is perceived by the interaction partner in the trust game. This pattern of higher investments by high perspective-takers remained consistent during repeated social interactions with a cooperative partner. However, all participants achieved a better mental model of their game partner with an increasing number of interactions, as demonstrated by increasing investments towards a cooperative partner and decreasing investments towards an unfair partner. Suggestive of a greater propensity to adapt to unfair social behaviour, the decrease of trust (decline of investments from the initial level) towards an unfair partner was significantly stronger for high perspective-takers.

Perspective-taking and social reciprocity

In adults, social reciprocity in the trust game is strongly predicted by the trustworthiness of the interaction partner (King-Casas et al., 2005). Decoding others' intentions from their behaviour and responding respectively necessitates perspective-taking. Therefore, we hypothesized that, during adolescence, the behaviour of high perspective-takers would be more contingent on their game partner's behaviour. Overall, participants showed less benevolent and more malevolent reciprocity during interactions with an unfair counterpart, as opposed to a cooperative counterpart. Despite the lower levels of baseline trust, i.e. a weaker signal of their positive social intentions and lower trust across game rounds, low perspective-takers engaged in benevolent reciprocity in 55% of all interactions, compared with 56% for high perspective-takers. In contrast to our expectations the difference in benevolent reciprocity towards a cooperative partner was not significant. Interestingly, high perspective-takers made significantly fewer benevolent and more malevolent moves than low perspective-takers during interactions with an unfair counterpart. In line with the associations between moral reasoning and judgement and a higher perspective-taking tendency in adolescents (Eisenberg et al., 2005; Myyrya, 2010), this finding may be explained by a higher sensitivity to the intentions of unfair others and a stronger tendency to punish unfair behaviour (Singer et al., 2006).

The impact of age, gender and estimated cognitive ability on perspective-taking, trust and social reciprocity

Our results showed no effect of age on the sensitivity to another person's perspective throughout adolescence: perspective-taking appeared stable between the ages of 13–18. This finding is in line with research by Dumontheil, Apperly, et al. (2010) and Dumontheil, Küster, et al. (2010), which showed no significant change in perspective-taking tendency from late childhood (age 9.8) through to adolescence (age 17.7). Their data suggested an increase in the usage of perspective-taking during the transition from adolescence (age 14–17.7) to adulthood (age 19.1–27.5). The current results also showed no effect of age on the degree of basic trust, on the development of trust across game rounds or on reciprocity towards the respective

game partner. Individual differences in trust and reciprocity during adolescence may rather be explained by individual differences in perspective-taking than by age-related processes per se. Previous research showed the most pronounced age-related changes in trust and reciprocity from childhood to adolescence and to a lesser degree from adolescence to adulthood (Sutter & Kocher, 2007) with more stable patterns in mid-adolescence (Van den Bos et al., 2010). In line with that, our findings indicate stable perspective-taking, trust and social reciprocity across the ages of 13–18. However, it is possible that we did not detect subtle age effects because of the relatively modest size of the current sample. Remarkably, adolescents with a high tendency to take others' perspectives into account showed very similar behavioural patterns to those of adults tested in a recent study, which utilized the same trust game paradigm to in a sample of 13–49 year old males (Fett et al., 2012). This finding implies that adolescents with a high perspective-taking tendency employ a more adult-like cognitive strategy.

Contrary to the view that females have a stronger tendency than males to take others' perspectives into account (Baron-Cohen, 2003) and consistent with recent data on gender differences by Knafo and colleagues (Knafo, Steinberg, & Goldner, 2011), no association was found between perspective-taking and gender. Other work has also demonstrated a higher degree of some social cognitive abilities and behaviours, such as pro-social moral judgement, sympathy and perspective-taking in women (measured by moral reasoning stories and subscales of the Interpersonal Reactivity Index, respectively), while no differences were present between men and women in self-reported helping, sharing or charity (Eisenberg et al., 2005). In line with previous research utilizing the trust game (Sutter & Kocher, 2007; Van den Bos et al., 2010), we did not find gender differences in trust. In our study, the only gender difference we found was more malevolent reciprocity of male participants towards an unfair interaction partner, which could reflect a greater inclination of males to punish unfair behaviour (Singer et al., 2006).

In all of our main analyses, we investigated the role of estimated cognitive ability. In line with previous research, we showed that the impact of perspective-taking tendency upon trust and social reciprocity was largely independent from estimated cognitive ability (Beauchamp & Anderson, 2010; Van den Bos et al., 2010). Higher estimated cognitive ability was associated with higher trust towards a cooperative counterpart, but this did not reduce the effects of perspective-taking tendency. Earlier work showed that higher IQ is associated with more pro-social behaviour (Gill & Prowse, 2013; Millet & Dewitte, 2007; Shaw, Vasquez, & LeClair, 2013). A positive relationship between intelligence and the tendency to value joint benefits more than one's own has been reported (Millet & Dewitte, 2007). Gill and Prowse (2013) suggested that higher cognitive ability translates into superior analytic reasoning and theory of mind in strategic environments. Accordingly, in the current study higher estimated cognitive ability could have contributed to an enhanced ability to decode the game partner's intentions and to a better planning of future behaviour in the trust game. In addition, higher cognitive ability may have contributed to an increased awareness of the fact that the highest cooperation yields the best pay-off for both game partners in the long run. Our findings further support the postulation that social cognitive ability is at least partly independent from more general non-social cognitive ability (Pellegrini, 1985; Tager-Flusberg, Skwerer, & Joseph, 2006). However, it should be noted that the assessment of cognitive ability in our study was rather limited, although the vocabulary subtest has been regarded as a good indicator of general cognitive functioning (Deutsch Lezak, Howieson, Bigler, & Tranel, 2012).

Limitations

The current findings should be interpreted in the light of the following issues. The perspective-taking task has frequently been referred to as a measure of theory of mind usage in online social interactions (Apperly et al., 2009; Dumontheil, Apperly, et al., 2010; Dumontheil, Hillebrandt, Apperly, & Blakemore, 2012; Dumontheil, Küster, et al., 2010; Keysar & Barr, 2000; Keysar et al., 2003; Lin, Keysar, & Epley, 2010). Yet, to what degree the task actually measures perspective-taking, as compared to visuo-spatial manipulation, is an issue of debate. There are some arguments in favour of perspective-taking. First, good performance on the perspective-taking task relies on a translocation of the egocentric viewpoint from the self to the other. As such, the task employs the same underlying logic as false belief paradigms, which dissociate the knowledge of the self and that of the other to assess the ability to take others' perspectives. Second, recent neuroimaging research has shown that social brain regions, and not brain regions typically activated during visuo-spatial tasks, are activated during the Director condition ((Dumontheil, Küster, et al., 2010) although we note that it is invalid to make concrete deductions about psychological mechanisms underlying a task from brain imaging data). This evidence is supportive of theory of mind, rather than visuo-spatial processing, as the underlying mechanism of perspective-taking in the current paradigm. Yet, future studies should investigate this issue further by including additional measures of theory of mind and visuo-spatial measures.

Another point that deserves attention is the assessment of our experimental manipulation in the trust game paradigm. 41% of participants indicated that they had doubts at some point during the trust game that they were playing with a human partner. Whether participants had doubts that they were playing a real human partner or not did not influence their trusting behaviour. Previous research, however, has shown that participants exhibit a different behavioural and neural pattern if they believe that they are playing a computer partner (Rilling, Sanfey, Aronson, Nystrom, & Cohen, 2004a, 2004b). The high percentage of people who reported doubts is likely due to the conservative way in which we assessed the credibility of our experimental manipulation: we asked participants whether they had any doubts that they were playing a real partner at any point in time during the experiment. Future research should address this question in a more fine-grained way as for example reported by Belli et al. (2012) who used a 7-point scale, with the extremes: 1 = never doubted that my opponent was a computer and 7 = never doubted that my opponent was a human (Belli et al., 2012). Additionally, the fact that participants

were asked retrospectively is important. Being asked after the task may have made participants suspicious and could have induced doubts, which may not have been present during the task itself.

Conclusions

The current study has shown an association between trust and perspective-taking tendency in adolescence, and provides evidence for the important role of perspective-taking in social behaviour towards others. A stronger inclination to take others' perspectives into account was associated with a more pro-social approach towards others and increased trust during cooperative interactions. In interactions with an unfair partner, this inclination was associated with a more drastic decrease of trust and less benevolent reciprocity. Our findings further elucidate the association between social cognition and social behaviour in adolescence, and highlight this phase as one of differentiated social behaviour, rather than one that is characterized by a generalized increase in pro-social behaviour towards others.

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Appendix A. Supplementary data

Supplementary data related to this article can be found online at http://dx.doi.org/10.1016/j.adolescence.2013.11.011.

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