Social Motivation and Naïve Theories in Children with Autism Spectrum Disorder

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Abstract

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Social motivation theory attempts to explain Autism Spectrum Disorder (ASD) symptomatology by suggesting that deficits in social motivation have downstream effects on children's socio-cognitive abilities, such as theory of mind (ToM; Chevallier, Kohls, Troiani, Brodkin, & Schultz, 2012). This theory posits that children with ASD would show social motivation deficits, such as a lack of social preference, and would show deficits in ToM, such as failing an implicit false belief task. An objective to the present study was to examine the association between tasks measuring social motivation and ToM abilities in typically developing (TD) children and children with ASD. ToM is an example of naïve psychology, a category of domain-specific core understandings. Another objective of this study was to extend work on the dissociation across naïve theories by exploring children's performance on naïve psychology, as well as naïve physics, and naïve biology. A biological motion and a static face preference task were administered on a split screen to measure social motivation. An implicit false belief task was administered to measure ToM (naïve psychology), a story sequencing task was used to measure naïve physics, and an understanding of "insides" was assessed to measure naïve biology. Tasks measuring social motivation were related to each other when assessed in TD children only. TD children but not children with ASD showed a social preference. Furthermore, children with ASD failed the implicit false belief task but not the naïve physics or naïve biology tasks. The present study replicates and extends previous findings, as well as strengthens the understanding of ASD symptomatology in the context of social motivation theory.

Acknowledgments

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Autism Spectrum Disorder (ASD) is a neurodevelopmental disorder with observable behaviour characterized by deficits in social communication and social interaction evident in multiple contexts, as well as restricted repetitive patterns of behaviour, interests, or activities (American Psychiatric Association, 2013). Since its identification by Leo Kanner in 1943, an extensive body of research has been generated from theories that could potentially explain ASD. A seminal study conducted by Baron-Cohen, Leslie, and Frith (1985) launched a cascade of research on the role of theory of mind (ToM) in children with ASD. In his mindblindness theory, Baron-Cohen (1995) proposed that said social and communicative symptoms might be due to specific deficits in ToM. ToM is defined as the understanding that others have mental states, such as intentions, beliefs, and desires, which may differ from one's own (Baron-Cohen et al., 1985; Leslie, 1987; Premack & Woodruff, 1978). There are various constructs subsumed under the concept of a ToM – diverse desires (e.g., two people can have different desires), diverse beliefs (e.g., two people can have different beliefs about an object), knowledge access (e.g., someone may have knowledge about a situation), false belief (e.g., someone is mistaken about the location of an object), and hidden emotions (e.g., someone may not display the emotions they are feeling at the moment) to name a few (Wellman & Liu, 2004; Wellman & Peterson, 2013). The most frequently used test for ToM is that of false belief, where the individual views a protagonist whose possession (e.g. a marble) is moved to a different location without his/her knowledge. In the traditional explicit false belief task, the individual is asked where the protagonist will look for the marble. In order to pass the false belief test, the individual must answer that the protagonist will search where he/she last saw the marble; thus attributing a false belief to the protagonist given that he/she was unaware that the marble had changed location.

Children typically pass false belief by the age of four (Frith, 2012; Wellman, Cross, & Watson, 2001). However, children with ASD continuously fail this task. For example, Baron-Cohen and colleagues (1985) tested 20 children diagnosed with ASD using the Sally-Anne test, a classic change-of-location ToM task. In this study, the children saw Anne move Sally's marble while Sally was not looking. When Sally returned, the children were asked to point where Sally would look for her marble. The researchers found that 80% of their participants (aged six to sixteen) with ASD failed the ToM task. The authors proposed that children with ASD failed to recognize that the protagonist had a false belief about the situation (Baron-Cohen, Leslie, & Frith, 1986). In fact, children with ASD only start to pass explicit measures of ToM between ages nine and eleven (Frith, 2012; Happé, 1995). Furthermore, they tend to pass the hidden emotion task earlier, which is typically harder than the false belief task (Peterson, Wellman, & Slaughter, 2012; Slaughter, 2015). It has been suggested that children with ASD fail the false belief task because it requires advanced pragmatic skills (Senju, 2012). For example, when asked "where will he/she look for the marble", children may pre-emptively process the "where" and look where the marble is actually located, thus failing the explicit false belief task (Csibra & Southgate, 2006). Moreover, the explicit false belief task involves several executive functions, such as working memory to remember the story sequence, and inhibitory control to prevent oneself from pointing to the correct location of the marble (Kimhi, 2014). For this reason, ASD researchers started using implicit versions of the false belief task, wherein children were not required to explicitly state (or point to) the correct answer (Senju, 2012). Such implicit false belief tasks were originally designed to test younger, nonverbal infants and were therefore thought to be useful in ASD research (Clements & Perner, 1994; Senju, 2012).

Accumulated results from infant research has shown that ToM is present in children much younger than four years of age when it is studied implicitly using anticipatory looking procedures (Clements & Perner, 1994; Poulin-Dubois, Brooker, & Chow, 2009; Southgate, Senju, & Csibra, 2007). For example, in a recent study, 18-month-olds were shown a classic change-of-location false belief video and their looking behaviour was captured using eye-tracking technology (Thoermer, Sodian, Vuori, Perst, & Kristen, 2012). In this video, a protagonist viewed a car move from one garage to the next, but when the protagonist was distracted, the car left the scene. The researchers calculated the ratio of duration of looking to the correct door to total duration of looking to both doors (differential looking score; DLS), where a score above 0.50 indicated a correct anticipatory response. A total of 55% of the 18-month-olds correctly anticipated where the protagonist would look for the car, suggesting that this task provides a conservative measure of implicit false belief. Since participants' looking behaviour is used as evidence of where they expect the protagonist to go, no explicit responses such as pointing or verbal answers are required. This paradigm addressed the pragmatic and some of the executive function issues raised from explicit false belief paradigms. Consequently, implicit false belief measures have been used in recent studies involving children with ASD. For instance, Senju and colleagues (2010) used eye-tracking technology to measure anticipatory looking in children with ASD aged six to eight years. These children had been previously diagnosed, by a child psychiatrist or pediatrician, with autistic disorder, Asperger disorder, pervasive developmental disorder – not otherwise specified, or pervasive developmental disorder without a detailed diagnosis. The children with ASD viewed a change of location task similar to the Sally-Anne task and DLS was used to measure whether children looked longer at the correct door than the incorrect door. The researchers found that children with ASD failed the implicit false belief task while the typically developing (TD) children correctly anticipated where the protagonist would look (Senju et al., 2010). In another study, children with ASD also failed to anticipate the correct location of the protagonist; correct anticipation was defined as looking longer at the correct location (Ruffman, Garnham, & Rideout, 2001). Thus, children with ASD's poor performance on false belief tasks cannot be fully explained by pragmatic or executive function demands.

There are several theories relating ToM deficits to ASD symptomatology. A prominent theory brought forward by Baron-Cohen and colleagues (1985; 1995) posits that children's social and communicative impairments can be explained by this ToM deficit. Throughout the years, several researchers have endorsed this theory (Loth, Gomez, & Happé, 2008; Senju, 2012). This view argues that since individuals with ASD have difficulty understanding another person's perspective, they cannot communicate effectively with others; ToM has downstream effects on social abilities (Kimhi, 2014). Likewise, children who are skilled at mindreading can communicate effectively with their peers (Slaughter, 2015). Not only is ToM a reliable measure of socio-cognitive abilities, it is also viewed as a representation of naïve psychology. Naïve psychology, defined as understanding that individuals' behaviours are associated to their mental states, is a concept stemming from naïve theories (Poulin-Dubois, Brooker, & Chow, 2009; Wellman & Peterson, 2013). Naïve theories are qualified as domain-specific core understandings that are central to children's cognitive development (Peterson & Siegal, 1997; Wellman & Gelman, 1992).

There are several domains, besides naïve psychology, that are under the umbrella of naïve theories (Peterson & Siegal, 1997). One such domain is that of naïve physics, defined as the understanding of mechanical functions and of physical properties (Baron-Cohen et al., 1986;

Peterson & Siegal, 1997). Baron-Cohen and colleagues (1986) studied naïve psychology, using picture sequencing of intentional understanding (e.g., girl puts teddy down and turns to pick a flower, boy takes the teddy, girl returns to see the teddy is gone), and naïve physics, using picture sequencing of physical properties (e.g., a balloon flies towards a tree and bursts on a branch). In this study, children were awarded two points if they correctly sequenced the stories and, one point if only the ending was correct. Three trials were administered for each condition for a possible total score of six. They found that children with ASD performed significantly worse than TD children on the naïve psychology task but performed significantly better than TD children on the naïve physics task. Children with ASD scored on average 1.76 out of 6 on the naïve psychology task. This led Baron-Cohen and his colleagues (1986) to propose that children with ASD have a specific deficit in naïve psychology (i.e. ToM) and that their naïve physics abilities are intact. With regard to naïve biology, to our knowledge, only one study has examined this form of knowledge in an ASD population. Peterson and Siegal (1997) found that children with ASD do not differ from TD children in their understanding of growth. However, naïve biology has been extensively examined in TD children (Inagaki & Hatano, 2006). For example, Gottfried and Gelman (2005) studied the understanding of biological "insides" in 3- to 5-year-olds. In this study, the 4- and 5-year-olds were able to accurately attribute animal "insides" to animals (e.g., the brain matched to the tapir) and mechanical "insides" to machines (e.g., the batteries matched to the intercom) yet the 3-year-olds failed the task (Gottfried and Gelman, 2005). Given that this study provided insight on the development of naïve biology in TD children, one goal of the current study was to study this concept in children with ASD.

A different theory that explains how the symptomatology of individuals with ASD develops is that of social motivation theory. This theory posits that children with ASD have early social motivation deficits, which prevent them from attending to and learning from social information in their environment, thus begetting socio-cognitive (i.e. ToM) deficits (Broekhof et al., 2015; Chevallier, Kohls, Troiani, Brodkin, & Schultz, 2012; Senju & Johnson, 2009). This general theory is not specific to ASD diagnoses – the authors argue that levels of social motivation should be related to ToM abilities across all populations (Chevallier et al., 2012). Thus one of the goals of the present study was to assess the relation between social motivation and ToM abilities in both TD children and children with ASD.

There are three ways to measure social motivation: social orienting, social reward, and social maintaining (Chevallier et al., 2012). Social orienting can be assessed using preferential looking techniques, where a social element and a non-social element are presented on a split screen. The participants' looking behaviour is recorded in order to determine whether they have a preference for one of the stimuli. For example, researchers have shown a split screen showing human biological motion and phase-scrambled motion to children with ASD aged three to seven years (Annaz, Campbell, Coleman, Milne, & Swettenham, 2012). These researchers found that TD children looked (measured in percentage of looking time) longer to the human biological motion, thus showing a preference for the social stimulus. In contrast, the children with ASD in this study did not look longer to the social stimulus, showing a lack of social motivation (Annaz, et al., 2012). In fact, children with ASD have often been shown in the literature to have a lack of preference for biological motion (Flack-Ytter, Rehnberg, & Bölte, 2013; Klin & Jones, 2008). However, there are discrepant findings in the literature; recent results indicated that both children with ASD and TD children perform similarly on a biological motion (i.e. a walking human) task, assessed using proportion of looking time to biological motion and non-biological motion (i.e. a truck; Wright, Kelley, & Poulin-Dubois, 2014). In another study by the same authors, both groups did not differ on visual exploration (number of saccades) between biological motion and non-biological motion (Wright, Kelley, & Poulin-Dubois, 2016). Furthermore, even TD children's performance on this biological motion task varies across studies, such as demonstrating a non-social preference in some studies (Wright, Kelley, & Poulin-Dubois, 2016). This discrepancy across the literature stresses the need to use more than one measure of social orienting since children's (both TD and with ASD) performance varies across studies.

Other researchers tackled the issue using eye-tracking technology to record visual exploration of social and non-social stimuli rather than using a preferential looking paradigm (Sasson, Turner-Brown, Holtzclaw, Lam, & Bodfish, 2008). These researchers used two types of non-social stimuli: high-autism interest (HAI) objects and low-autism interest (LAI). HAI objects were defined as being part of circumscribed interests for individuals with ASD (e.g., trains), whereas LAI objects were defined as not being part of this circumscribed category (e.g., clothing). In this study, the participants viewed arrays comprised of social images paired with either HAI or LAI objects, for a total of six social and object arrays. The researchers measured the number of different images explored in an array using eye-tracking data on the number of fixations to defined areas of interest in the arrays. Children with ASD aged 6 to 17 years looked less at the social stimuli if it was paired with an HAI object (Sasson et al., 2008). These results were replicated in a later study with 2- to 5-year-olds (Sasson, Elison, Turner-Brown, Dichter, & Bodfish, 2011). Together, these findings demonstrate that children with ASD do not show social motivation (i.e. they do not orient more towards social stimuli). However, these researchers did not use total or proportion of gaze duration to the stimuli; they used number of stimuli viewed. It is difficult to draw conclusions since participants can look at more (frequency) non-social objects but for a short duration, and vice versa. This is why Sasson and colleagues (2008; 2011) describe their variable as a measure of visual exploration rather than social preference. There is little research aimed at exploring the relationship between this lack of social motivation and ToM deficits. To our knowledge, the only other study examining both ToM and social motivation in children with ASD was conducted by Chevallier and colleagues (2014). These researchers investigated the audience effect in children with and without ASD when completing a ToM task; this audience effect was measured by having the experimenter either present or absent during the administration of the task. The authors found that TD children performed better on the ToM task when it was administered by the experimenter (vs. by a computer), whereas children with ASD's performance did not differ. The authors argued that this indicated that TD children showed a social motivation but not the children with ASD. The children in this study were on average 10-years-old, social motivation was not assessed by measuring social orienting, and the ToM task was explicit in nature. Therefore, the present study is the first to examine the link between social orienting and an implicit false belief task in children with ASD aged 3 to 6 years. Another goal of the current study was to use more than one measure of social motivation and to examine the relation between children's performance on said social motivation tasks. To achieve this goal, both a biological motion and static face task were used.

In summary, the objectives of the present study were to 1) explore the relations between social motivation tasks, 2) examine the association between tasks measuring social motivation (i.e. social orienting) and ToM abilities (implicit false belief) and 3) extend work on the dissociation across naïve theories by exploring children's performance on naïve psychology, naïve physics, and naïve biology. The ToM task used was adapted from Thoermer and colleagues' (2012) change-of-location implicit false belief task, which served as the socio-cognitive measure for the second objective and as the naïve psychology measure for the third objective. Two experiments were conducted, where the first experiment addressed the above three objectives in TD children in order to better understand the relation between the tasks. The second experiment addressed the same objectives in both TD children and children with ASD. Social motivation was assessed using two types of stimuli: a biological motion measure adapted from Annaz and colleagues (2012), and a static face measure adapted from Sasson, Dichter, and Bodfish (2012). The static face measure encompassed two types of non-social stimuli: HAI objects and LAI objects (Sasson et al., 2012). The naïve physics measure consisted of story-sequencing task involving physics properties (adapted from Baron-Cohen et al., 1986). The naïve biology measure consisted of a matching task involving animal and machine “insides” (adapted from Gottfried & Gelman, 2005).

Experiment 1

As per the social motivation theory, we examined whether TD children’s performance on two social motivation tasks would be associated with their performance on the ToM task. Furthermore, it was hypothesized that TD children’s performance on the individual social motivation tasks would be positively associated with each other, indicating that both tasks reliably measure social motivation. TD children were expected to pass the implicit false belief task and they were expected to show a preference for the social stimuli in the social motivation tasks. It was hypothesized that their performance on the naïve psychology, naïve physics, and naïve biology tasks would be equivalent. However, we also expected developmental changes in children’s performance on these three tasks.

Method

Participants. Forty children aged 2 to 7 years (25 boys and 15 girls; mean age = 4.23 years, range = 2.08–7.50), who were recruited from a laboratory database, participated in this study; thirty-six spoke English, and four spoke French. Of these, fourteen participants were excluded in the analyses because the task was not recorded for the biological motion task (n = 3), static face (n = 7), or the ToM task (n = 4).

Materials. The biological motion, static face, and ToM tasks were administered on a 23 inch monitor. The training condition of the naïve physics task consisted of four stories not involving physics concepts: 1) a girl eating a banana, 2) a boy going fishing, 3) a boy playing with blocks, and 4) a girl playing on a slide. The test condition of the naïve physics task included: 1) a man kicking a rock, 2) a balloon flying into a tree, 3) an egg falling off a table, and 4) tumbling rocks. Each of these stories were depicted on three 9 cm X 8 cm laminated cards with Velcro on the back of each card so they could be placed on the storyboard. The naïve biology task consisted of target images on 21.59 cm X 27.94 cm laminated cards and “inside” images on 7.5 cm X 5 cm laminated cards. A white 7.5 cm X 5 cm rectangle and Velcro was placed on the center of each target image on which an “inside” card can be placed. The training condition consisted of two target images of familiar furniture (refrigerator and dresser). The “insides” of the training condition consisted of familiar food (an apple, milk, and a sandwich) and familiar clothing (dress, sweater, and jeans). The target images of the test condition consisted of four unfamiliar animals (eland, pacarana, tapir, and cavy) and four unfamiliar machines (electric razor, intercom, mini TV, and espresso maker). The test condition consisted of four animal “insides” (lungs, bones, muscle, and heart), and four mechanical “insides” (gears, wire, battery, and circuit board).

Procedure. Each child participated in two visits in our laboratory. During the first visit, the participants’ parents were explained the study in detail and asked to sign the consent form. The parents completed a demographic questionnaire and the current version of the Social

Communication Questionnaire (SCQ; Rutter, Bailey, & Lord, 2003). The SCQ is a 40-item standardized questionnaire that was developed to screen for symptoms and behaviours associated with ASD. Each participant completed a total of seven tasks: two social motivation tasks (static face and biological motion), one socio-cognitive task (implicit false belief), two naïve theory tasks (naïve physics and naïve biology) and two cognitive measures (Differential Ability Scale and the Peabody Picture Vocabulary Test, see Table 1). The order of the tasks was counterbalanced across each visit. The video tasks were administered in one block and the interactive tasks were administered in a separate block in order to avoid breaking the participants' concentration. The order of the tasks within these blocks was counterbalanced and the order in which the blocks were presented was randomized. To code their looking time during the video tasks participants were filmed using a webcam.

Table 1

Mean chronological age, non-verbal mental age, verbal mental age, and social communication questionnaire scores

Statistic	CA (in years)	DAS-NVMA (age equivalent in years)	PPVT-VMA (age equivalent in years)	SCQ Scores
Mean	4.23	4.58	4.89	4.36
SD	1.26	1.33	1.55	3.21
Range	2.08–7.50	2.58–7.58	1.83–7.42	0–11

Biological motion. This task was adapted from Annaz and colleagues (2012). Point-light displays of a walking human and of a phase-scrambled walking human were presented on a split screen. Eight trials were presented for 6 seconds each. Each display consisted of 13 point-light dots, which were placed on major parts of the human (e.g. one head, two shoulders, two elbows, two hands, two hips, two knees, and two feet). The phase-scrambled display was created by making the motion trajectories play temporally out of phase. Half of the trials were shown to be moving towards the right. The side on which the human was presented and the order of each video (right/left walking) were counterbalanced. A central fixation cross accompanied by a ring sound was presented prior to each trial in order to orient children's attention to the screen.

Figure 1. A still screen of the biological motion stimuli with the human walking on the left and the scrambled motion on the right.

Static face. This task was adapted from Sasson and colleagues (2012). Pictures of humans and objects were presented on a split screen. Twenty trials were presented for 5 seconds each. The 20 pictures of humans consisted of 10 males and 10 females, ranging in age (babies to elderly people) and ethnicity. The 20 pictures of objects consisted of 10 HAI objects (two vehicles, two signs, two sets of blocks, two electronics, and two clocks) and 10 LAI objects (two pieces of clothing, two instruments, two plants, two tools, and two pieces of furniture). The side on which the human was presented and the order of male/female human and HAI/LAI object were counterbalanced. A central fixation cross accompanied by a ring sound was presented prior to each trial in order to orient children's attention to the screen.

Figure 2. An example of the social/non-social pairs in the static face task, with a HAI object on the left and a human face on the right.

Theory of mind. This task was adapted from Thoermer and colleagues (2012). Three short videos were shown in succession: two familiarization videos (26 seconds each) and a test video (35 seconds). The familiarization videos showed a protagonist watching a car moving from a garage on one end of the screen to the other garage at the other end. Following this, a chime signalled the two doors above each garage turning bright red for three seconds, serving as the anticipatory looking period. Then the protagonist came out of the door above the garage containing the car; the protagonist then grabbed the car. A “pass” was defined as the participants’ first look at the correct door (where the car is located). Other researchers who assessed anticipatory looking in toddlers and preschoolers also used first look as their dependent variable (Clements & Perner; 1994; Southgate et al., 2007). All participants included in this task passed at least one familiarization trial. The test trial also showed the protagonist watch the car move across the screen. However, a phone ring distracted the protagonist, preventing her from seeing the car backing up until it disappeared from the screen. Following the anticipatory period, the protagonist came out of the door above the garage where she had last seen the car. A “pass” was defined as the participants’ first look to the correct door (where the protagonist last saw the car). An attractive attention-getter (a green circle) paired with a ring was presented prior to each trial in order to orient children’s attention to the screen.

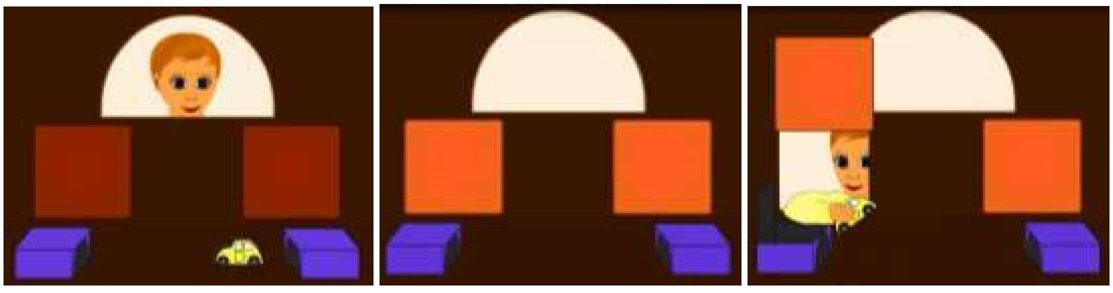

Figure 3. Three still screens depicting one of the familiarization trials of the ToM task.

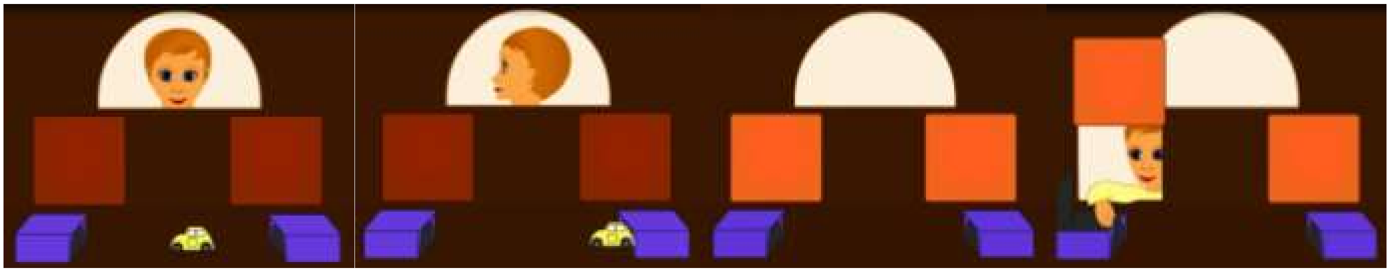

Figure 4. Four still screens depicting a test trial of the ToM task.

Naïve physics. This task was adapted from Baron-Cohen and colleagues (1986). Participants were shown three cards depicting a story (e.g. girl is near a slide, girl goes up the ladder, girl goes down the slide). The first card of each training trial was placed on the story board and the participants were asked "what comes next?" – prompting them to place the two remaining cards in order on the story board. Participants received a point for each story that was placed in the correct order. All participants included in this task passed at least two training trials. Following this, the four test trials were administered in the same manner. The participants received a score out of four and a proportion of correct responses was calculated.

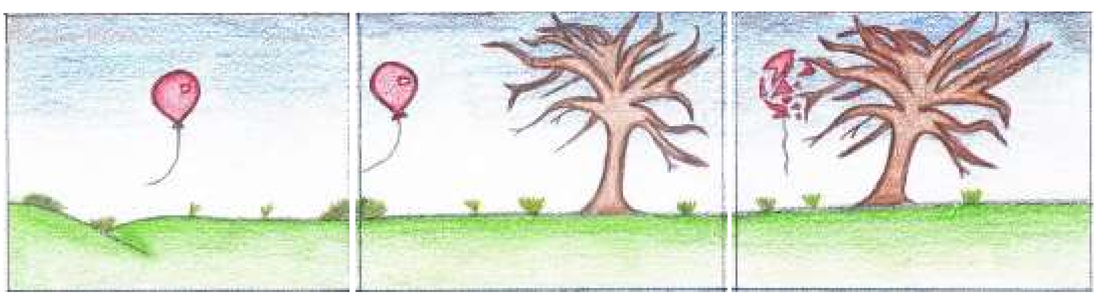

Figure 5. An example of a sequence of images used in the naïve physics task.

Naïve biology. This task was adapted from Gottfried and Gelman (2005). Participants were shown one of the training target image and two training "insides" (one depicting food and the other depicting clothing). The experimenter pointed to the white rectangle on the target image and asked “which one goes here?”. The participants’ first response was coded, receiving a point if the food was placed on the fridge and if the clothing was placed on the dresser. All participants included in this task passed at least two training trials. Following this, the eight test trials were administered, where each target image was paired with one animal “inside” and one mechanical “inside”. Participants received a score out of eight on the test trials and a proportion of correct responses was calculated.

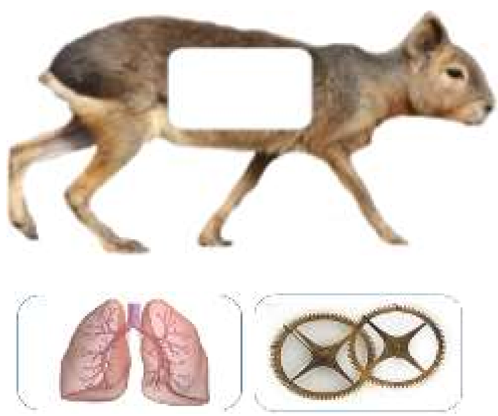

Figure 6. An example of an animal target image and two possible “insides”.

Coding. An experimenter blind to the hypothesis of the study coded the participants’ looking behaviour from the recorded videos for the biological motion, static face, and ToM tasks. A second experimenter coded 30% of the videos to establish reliability for each task. For each trial of the biological motion task, the experimenters coded duration of looking to each side of the screen. The Cohen kappa inter-rater reliability was 0.84. The primary experimenter calculated the total duration each participant looked at the human (social) and at the phase-scrambled human (non-social). The proportion of looking at the human was calculated for each participant. For each trial of the static face task, the experimenters coded duration of looking to each side of the screen. The Cohen kappa inter-rater reliability was 0.92. The primary experimenter calculated the total duration each participant looked at the human (social) at the HAI and LAI objects (non-social). The proportion of looking at the human was calculated for each participant. For each trial of the theory of mind task, the experimenters coded each look made to the right door and to the left door during the anticipatory looking period. The Cohen kappa inter-rater reliability was 0.82. The primary experimenter coded whether the first look during the anticipatory period was to the correct door.

Results and Discussion

Participants' chronological age, non-verbal mental age, verbal mental age, and SCQ scores were normally distributed and there were no outliers. Using a z-score cut-off of 2.5, there was one outlier among participants' performance on the biological motion task. This participant was excluded from the analyses. Following this exclusion, participants' performance on this task was normally distributed. Participants' performance on the static face task, ToM task, naïve physics, and naïve biology tasks were normally distributed and there were no outliers.

Chance Analyses. Thirty-six participants were included for the biological motion task. On average, participants looked at the social stimuli longer than at the non-social stimuli (M = .53, SD = .09; $t(35) = 2.18$, $p = .036$, 95% CI [.002, .067], $d = .363$; see Figure 1). Thirty-three participants were included for the static face task. On average, participants also looked at the social stimuli longer than at the non-social stimuli (M = .55, SD = .09; $t(32) = 3.32$, $p = .002$, 95% CI [.020, .083], $d = .578$; see Figure 1). Separate analyses were conducted for the social images paired with HAI objects and for the social images paired with the LAI objects. Participants looked longer at the social stimuli when it was paired with an LAI object (M = .59, SD = .11; $t(32) = 5.02$, $p = .000$, CI [.055, .130], $d = .875$; see Figure 2) but performed at chance when the social stimuli were paired with a HAI object (M = .52, SD = .09; $t(32) = .96$, $p = .344$, CI [-.018, .049], $d = .168$; see Figure 2). A total of 44% of the participants passed the ToM task. Since a pass/fail criterion is used for this task, a non-parametric binomial test was conducted; the participants performed at chance on the ToM task (p = .618, d = -.110). Thirty-six participants were included for the naïve physics task. On average, participants performed well above chance (50%) on that task (M = .78, SD = .22, $t(35)$ = 7.88, p = .000, CI [.211, .358], d = 1.314; see Figure 3). All participants were included for the naïve biology task. On average, participants also performed well above chance (50%) on that task (M = .81, SD = .20, $t(39)$ = 9.90, p = .000, CI [.243, .368], d = 1.565; see Figure 3). There was no difference in performance on the naïve biology task and the naïve physics task, t(35) = -1.082, p = .287, CI [-.116, .035], d = -0.199.

Correlational Analyses. The False Discovery Rate procedure suggested by Benjamini and Hochberg (1995) was used to correct for multiple comparisons. Non-verbal age equivalent was statistically significantly correlated with both naïve physics and naïve biology proportion of correct responses (see Table 2). Participants' chronological age was also statistically significantly correlated with naïve physics and with naïve biology proportion of correct responses. These were the only tasks correlated with participants' chronological age and non-verbal age equivalents. Participants' performance on the biological motion task was statistically significantly correlated with participants' performance on the static face task. Participants' performance on the biological motion task was also statistically significantly correlated with participants' performance on the static face task when the social images were paired with the LAI object; it was not correlated with participants' performance on the static face task when the social images were paired with the HAI object. Furthermore, participants' performance on the naïve physics task was statistically significantly correlated with their performance on the naïve biology task. Participants' SCQ scores were not correlated with their performance on any of the tasks. Moreover, participants' performance on the ToM task was not correlated with their performance on any of the other tasks.

Table 2

Zero-order correlations between measures for TD children in Experiment 1.

	DAS	Age	SCQ	Bio. Motion	Static HAI	Static LAI	Static Total	ToM	Naïve Physics	Naïve Biology
DAS	1	.883*	.054	-.283	-.039	-.037	-.046	.121	.350*	.575*
Age	-	1	.153	-.158	.009	-.024	-.010	.097	.482*	.557*
SCQ	-	-	1	-.069	.129	.124	.144	.065	-.195	-.069
Bio. Motion	-	-	-	1	.209	.504*	.449*	-.050	.160	-.154
Static HAI	-	-	-	-	1	.521*	.853*	-.032	.151	.077
Static LAI	-	-	-	-	-	1	.879*	.296	-.027	-.227
Static Total	-	-	-	-	-	-	1	.145	.065	-.077
ToM	-	-	-	-	-	-	-	1	.091	-.149
Naïve Physics	-	-	-	-	-	-	-	-	1	.396*
Naïve Biology	-	-	-	-	-	-	-	-	-	1

NOTE: * indicates that the correlation is significant after the false discovery rate procedure (Benjamini & Hochberg, 1995) was applied, where the adjusted alpha is less than .05.

It was hypothesized that TD children's performance on the two social motivation tasks would be positively associated with their performance on the ToM task, which measures a critical construct of naïve psychology. This hypothesis was not supported as the relation between results on the ToM task and the static face and biological motion tasks were not significant. In other words, TD children's motivation to orient to social stimuli, whether static or dynamic in nature was not related to their ability to attribute a mental state, specifically a false belief, to a protagonist. It was also hypothesized that the TD children's performance on the individual social motivation tasks would be positively related to each other. As expected, the link between the static face and the biological motion tasks was positive and moderate, indicating that individuals who show a social preference with static stimuli also show a social preference with dynamic stimuli that are degraded, such as point-light displays. As expected, results from this group of TD children also indicate that TD children show a social preference on both types of stimuli (Figure 7). Interestingly, TD children do not show this social preference when the social stimuli are paired with an object deemed highly salient to children with ASD (i.e. HAI object; Figure 8). Similar results were found by Sasson and colleagues (2011), who showed similar stimuli to TD children and children with ASD aged 2 to 5 years. These researchers did not assess social preference per se, but did measure children's exploration and fixation patterns when viewing arrays of social and non-social stimuli (i.e., HAI and LAI objects). The researchers found that children with ASD explored more the HAI objects than the LAI objects, whereas the TD children seemed to explore the two types of objects equally (Sasson et al., 2011). The findings in the present study suggest that TD children might find the HAI images more salient than the LAI as well and that this attention to saliency might not be specific to children with ASD. In the literature, social preference is commonly studied using one type of social stimuli (e.g., static, dynamic, auditory, interactive). Given that these stimuli are seldom administered to the same participants, the present results provide further evidence that these tasks measure the same concept: social motivation. Furthermore, these results allow us to observe social motivation using different modalities; the biological motion task exhibits the motion typical of a social figure in a point-light display. The static face task exhibits a social stimulus made from naturalistic pictures of humans of various ages and ethnicities, which is a more ecologically-valid type of social stimuli. Thus, we can extend the understanding of children's social motivation across different modalities.

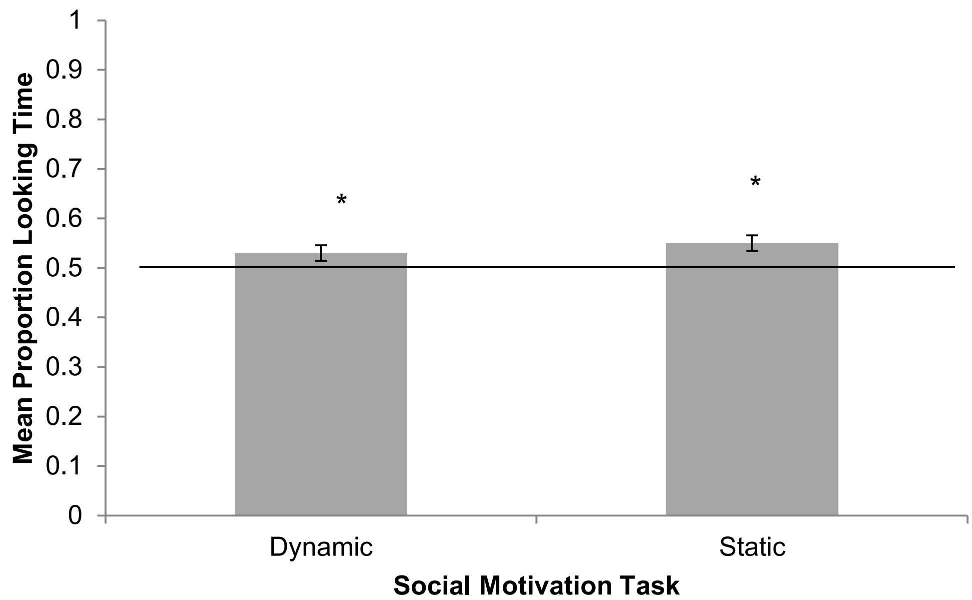

Figure 7. Mean proportion of looking time at the social stimuli on the social motivation tasks.

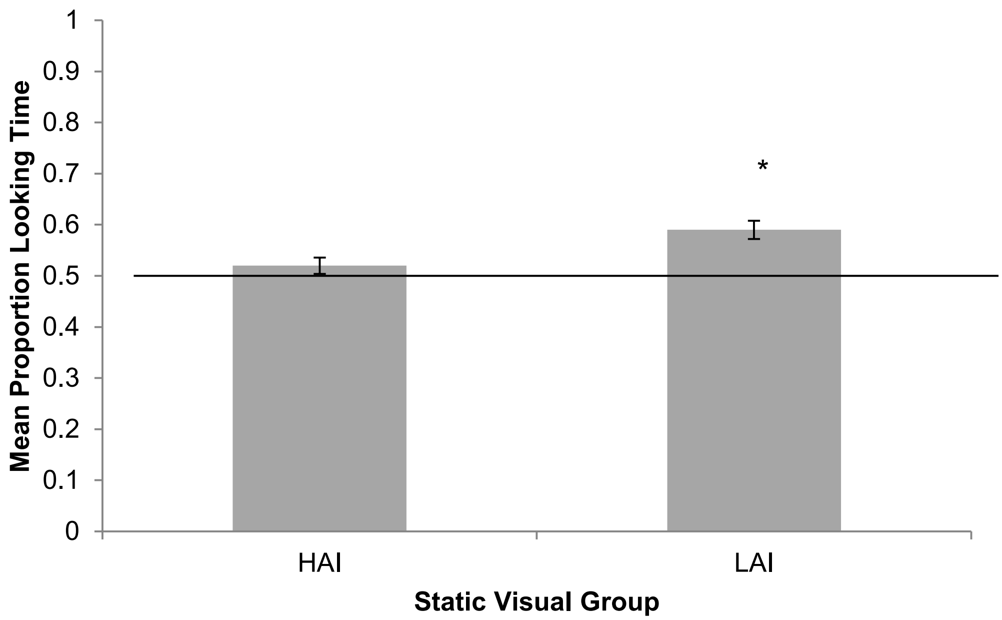

Figure 8. Mean proportion of looking time at the social stimuli on the static face task in HAI and LAI object conditions.

It was expected that TD children would pass the implicit false belief task. However, about half of the children succeeded on this ToM task. The test object (a car) in the two familiarization videos shown before the test video never leaves the scene. In the test video, the car leaves the scene in the absence of the protagonist's knowledge. This ToM paradigm was designed by Thoermer and colleagues (2012), who reported that 55% of 18-month-olds passed the implicit false belief task. Southgate and colleagues (2007) also used a similar paradigm where the test object is removed from the scene during the test trial. In this study, 85% of 2-year-old children correctly anticipated the protagonist's actions. However, in this paradigm the test object is a ball that is removed from the scene by a puppet. This paradigm was also used with older children aged 6 to 8 years; 71% of the children passed this implicit false belief task. In the present study, the test object appears autonomous as it moves without external support and the children looked randomly to one of the two doors on the screen. Thus, it is possible that the children who failed the ToM task (first look to the side of the screen where the car disappeared) expected the car to come back to the scene. The toddlers in Thoermer and colleagues' study (2012) were younger and may not have processed the video as the older children did in our study, which may explain why the success rate in our study is lower than in the aformentioned study. Future studies could include a familiarization video where the car leaves the scene to determine whether or not this novel action explains why TD children performed at chance on this task. Grosse Wiesmann, Friederici, Singer, and Steinbeis (in press) assessed implicit false belief in preschoolers aged 3- and 4-years-old. These researchers presented ten familiarization trials and 12 test trials. In this study, both the 3-year-old and the 4-year-old children performed significantly above chance on the implicit false belief task. It is possible that the reason why the TD children in the present study did not perform statistically significantly above chance is because they viewed only one trial. The reason only one trial was shown was to minimize the risk of fatigue since several tasks administered during their visit.

With regards to the naïve theories investigated in the present study, it was hypothesized that children’s performance on the ToM task would be correlated to their performance on the naïve physics and naïve biology tasks. Only the naïve physics and the naïve biology tasks were positively correlated with each other. Furthermore, TD children’s performance was not different on these two tasks. In other words, children who were able to complete the sequence of stories depicting physics concepts were equally able to match animal and mechanical “insides” to their target images. This hypothesis was exploratory in nature since to the best of our knowledge, the relation between these three domain-specific theories has not yet been assessed with a within-subject design. Although naïve physics and naïve biology are domain-specific, the children were expected to infer the content of the stimuli (i.e., infer that lungs were “animal insides”). Thus, the children were expected to make inductive inferences across domains. Nevertheless, only the naïve physics and naïve biology tasks were found to be related. A possible explanation as to why our initial hypothesis was not supported is that both naïve physics and naïve biology involve reasoning, whereas naïve psychology is based more on social interactions and is related to mental state talk (Ruffman, 2014). Furthermore, the naïve psychology task measured anticipatory responses using a visual attention paradigm; results may differ if a standard task (such as an explicit false belief task) was used. In summary, children with good theory building abilities involving reasoning would perform well on the naïve physics and naïve biology tasks, but not necessarily on the naïve psychology task. In order to excel in all three naïve theories, both strong reasoning abilities and well established social-interaction knowledge is needed. Future studies could investigate this hypothesis by controlling for mental state talk between children and their caregivers. The naïve biology task was correlated with non-verbal mental age equivalent; suggesting that the understanding of biological “insides” has a developmental trajectory in TD children. Parallel results were found by Gottfried and Gelman (2005), where the older children in their sample passed the naïve biology task, but the younger children struggled with the understanding of “insides”.

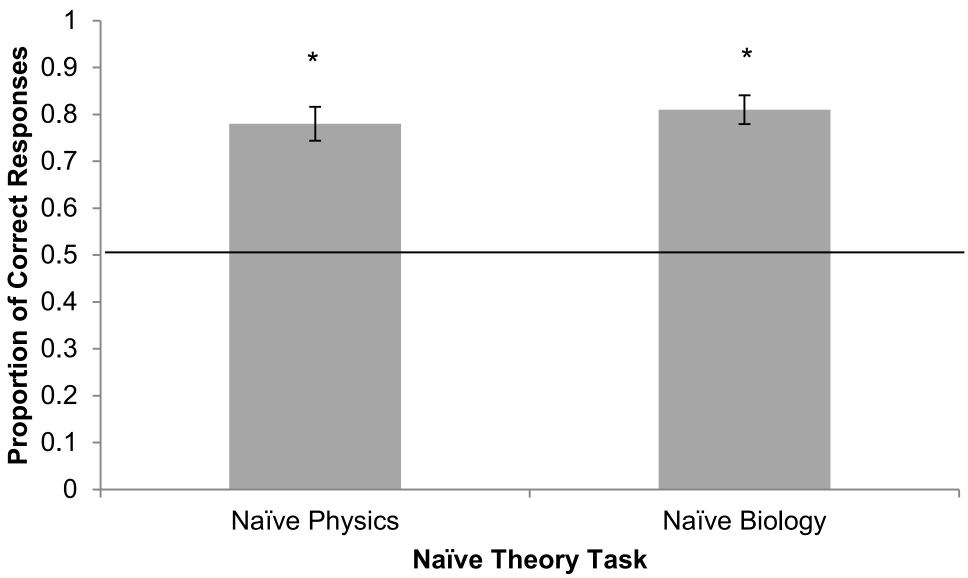

Figure 9. Proportion of correct responses on the naïve theory tasks.

Experiment 2

Because social motivation theory posits that level of social motivation is associated with ToM abilities regardless of diagnosis, we expect this relation to be present in both TD children and children with ASD. TD children's performance was expected to be as in Experiment 1 but children with ASD were expected to fail the ToM task and to have deficits in social motivation. It was hypothesized that children with ASD would fail the naïve psychology task but not the naïve physics task since it has been shown that this population does not have deficits in this domain-specific area. With regard to naïve biology, one might expect no deficit as well. To the best of our knowledge, this study is the first to integrate social motivation theory and naïve theories in children with ASD.

Method

Participants. Participants were recruited from a hospital database, from specialized centers for children with ASD, and from provincial and municipal Autism organizations. The participants included in the study had previously received a primary diagnosis of ASD from licensed psychologists or pediatricians by satisfying diagnostic criteria on the Autism Diagnostic Observation Schedule (ADOS; Lord et al., 2000). Seventeen participants diagnosed with ASD aged 3 to 7 years participated in the study. One participant was excluded due to fussiness. The final ASD sample consisted of sixteen English- and French-speaking participants (16 boys; mean age = 5.22 years, range = 2.08–7.08). Participants were excluded in the analyses if the task was not recorded for the biological motion task (n = 1), static face (n = 1); none were excluded from the ToM task. The results of sixteen TD participants from experiment one were included in this experiment in order to serve as control group (8 boys and 8 girls; mean age = 3.98 years, range 2.08–7.50). Thirteen participants spoke English and three spoke French. The TD and the ASD participants were matched on non-verbal mental age (see Table 3). All of these participants were included in the analyses since all of their tasks were recorded.

Table 3

Mean chronological age, non-verbal mental age, verbal mental age and social communication questionnaire scores for the ASD and TD children

Group	Statistic	CA (in years)	DAS-NVMA (age equivalent in years)	PPVT-VMA (age equivalent in years)	SCQ Scores
TD	Mean	3.98	4.28	4.72	4.13
	SD	1.49	1.56	1.79	3.90
	Range	2.08–7.50	2.58–7.42	1.83–7.42	0–11
ASD	Mean	5.22	4.36	4.06	16.67
	SD	1.36	1.87	1.85	6.85
	Range	3.08–7.08	2.58–7.83	2.17–7.25	7–27

Materials and Procedures. The materials, procedures, and coding were the same as in experiment one.

Results and Discussion

In both groups, participants' chronological age, non-verbal mental age, verbal mental age, and SCQ scores were normally distributed and there were no outliers. In both groups, participants' performance on the biological motion, static face task, ToM task, naïve physics, and naïve biology tasks were normally distributed and there were no outliers.

Chance Analyses.

TD group. All sixteen participants were included for the biological motion task. On average, participants looked at the social stimuli longer than at the non-social stimuli (M = .57, SD = .10; t(15) = 2.67, p = .017, 95% CI [.014, .120], d = .668). All participants were included for the static face task. On average, participants looked at the social stimuli longer than at the non-social stimuli (M = .56, SD = .10; t(15) = 2.29, p = .037, 95% CI [.004, .107], d = .573). Participants looked longer at the social stimuli when it was paired with an LAI object (M = .61, SD = .12; t(15) = 3.67, p = .002, CI [.045, .171], d = .917). Participants performed at chance when the social stimuli was paired with a HAI object (M = .51, SD = .09; t(15) = .25, p = .807, CI [-.044, .056], d = .062). A total of 63% of the participants passed the ToM task, a proportion not different than expected by chance (p = .454, d = .250). Fifteen participants were included for the naïve physics task. On average, participants performed well above chance on that task (M = .75, SD = .23, t(14) = 4.18, p = .001, CI [.122, .378], d = 1.080). All participants were included for the naïve biology task and they performed well above chance on that task (M = .78, SD = .23, t(15) = 4.83, p = .000, CI [.154, .397], d = 1.207).

ASD group. Fifteen participants were included for the biological motion task. Participants performed at chance; they looked equally long at the social and non-social stimuli (M = .53, SD = .16; $t(14)$ = .791, p = .442, 95% CI [-.056, .121], d = .204). Fifteen participants were included for the static face task. Overall, participants performed at chance (M = .52, SD = .16; $t(14)$ = .58, p = .569, 95% CI [-.066, .115], d = .151). Participants also performed at chance when the social stimuli was paired with a LAI object (M = .55, SD = .18; $t(14)$ = .98, p = .344, CI [-.055, .146], d = .253) and when the social stimuli was paired with a HAI object (M = .51, SD = .18; $t(14)$ = .18, p = .860, CI [-.089, .106], d = .046). A total of 31% of the 16 participants passed the ToM task; the participants performed at chance on the ToM task (p = .210, d = -.392). Fourteen participants were included for the naïve physics task. On average, participants performed well above chance on that task (M = .69, SD = .26, $t(13)$ = 2.71, p = .018, CI [.039, .342], d = .724). Participants included for the naïve biology task (N=15) performed well above chance on that task (M = .68, SD = .27, $t(14)$ = 2.54, p = .024, CI [.028, .327], d = .654).

Correlational Analyses.

TD group. Verbal mental age equivalent was statistically significantly correlated with naïve biology proportion of correct responses (see Table 4). This was the only task correlated with participants' verbal and non-verbal age equivalents. Participants' performance on the biological motion task was not correlated with participants' performance on the static face task. Furthermore, participants' performance on the naïve physics task was not statistically significantly correlated with their performance on the naïve biology task. As in experiment one, participants' SCQ scores were not correlated with their performance on any of the tasks. Participants' performance on the ToM task was not correlated with their performance on any of the other tasks.

Table 4

Zero-Order correlation between measures for TD children in Experiment 2.

	DAS	PPVT	SCQ	Bio. Motion	Static HAI	Static LAI	Static Total	ToM	Naïve Physics	Naïve Biology
DAS	1	.896*	.113	-.263	-.322	-.031	-.160	.315	.294	.603
PPVT	-	1	.154	-.182	-.048	.022	.011	.049	.281	.695*
SCQ	-	-	1	.032	.198	.313	.303	.197	-.259	.080
Bio. Motion	-	-	-	1	.121	.319	.315	-.219	.087	-.095
Static HAI	-	-	-	-	1	.539	.838*	-.082	-.045	.167
Static LAI	-	-	-	-	-	1	.902*	.343	-.385	-.392
Static Total	-	-	-	-	-	-	1	.164	-.250	-.290
ToM	-	-	-	-	-	-	-	1	.000	-.284
Naïve Physics	-	-	-	-	-	-	-	-	1	.364
Naïve Biology	-	-	-	-	-	-	-	-	-	1

NOTE: * indicates that the correlation is significant after the false discovery rate procedure (Benjamini & Hochberg, 1995) was applied, where the adjusted alpha is less than .05.

ASD group. Non-verbal age equivalent was statistically significantly correlated with naïve physics proportion of correct responses and with naïve biology proportion of correct responses (see Table 5). Verbal mental age equivalent was only statistically significantly correlated with naïve physics proportion of correct responses. These were the only tasks correlated with participants' verbal and non-verbal age equivalents. Participants' performance on the biological motion task was not correlated with participants' performance on the static face task. The correlation between participants' performance on the naïve physics task and their performance on the naïve biology task was not statistically significant but it was trending (*p* =.063). In this group as well, participants' SCQ scores were not correlated with their performance on any of the tasks. Participants' performance on the ToM task was not correlated with their performance on any other tasks.

Table 5

Correlational analyses between measures for children with ASD.

	DAS	PPVT	SCQ	Bio. Motion	Static HAI	Static LAI	Static Total	ToM	Naïve Physics	Naïve Biology
DAS	1	.875*	-.285	-.316	-.212	-.099	-.169	-.226	.723*	.597*
PPVT	-	1	-.252	-.242	.314	-.271	-.321	-.130	.686*	.555
SCQ	-	-	1	.570*	.089	-.092	-.008	-.285	-.436	-.389
Bio. Motion	-	-	-	1	.165	-.218	-.041	-.139	-.235	-.607*
Static HAI	-	-	-	-	1	.686*	.913*	.180	-.485	-.564
Static LAI	-	-	-	-	-	1	.922*	-.112	-.299	-.261
Static Total	-	-	-	-	-	-	1	.042	-.429	-.436
ToM	-	-	-	-	-	-	-	1	-.265	.067
Naïve Physics	-	-	-	-	-	-	-	-	1	.510
Naïve Biology	-	-	-	-	-	-	-	-	-	1

NOTE: * indicates that the correlation is significant after the false discovery rate procedure (Benjamini & Hochberg, 1995) was applied, where the adjusted alpha is less than .05.

Between group comparisons. A repeated measures group (TD vs. ASD) X social motivation tasks (biological motion vs. static face) ANOVA was conducted. There were no main effects or interaction found; both groups performed equally on both social motivation tasks (see Figure 4). A repeated measures group (TD vs. ASD) X static face group (HAI vs. LAI) ANOVA was conducted. A main effect of static face group was found, $f(29) = 9.92$, $p = .004$, $d = .255$. Post-hoc paired samples t-test were conducted; both groups looked longer at the social stimuli when it was paired with an LAI object, $t(30) = -3140$, $p = .004$, $d = .488$ (see Figure 5). A repeated measures group (TD vs. ASD) X naïve theory tasks (naïve physics vs. naïve biology) ANOVA was conducted. There were no main effects or interaction found; both groups performed equally on both naïve theory tasks (see Figure 6). A group (TD vs. ASD) X ToM (pass vs. fail) was conducted to determine whether both groups performed differently on the

ToM task. The chi-square was not statistically significant but, as expected, there was trend for TD children to perform better ($\chi^2 = 3.14$, $p = .077$, $V = .313$).

It was hypothesized that a relation between the two social motivation tasks and the ToM task would be observed for the ASD group. The relation between the social motivation tasks and the ToM task was not significant in the ASD group, suggesting that children with ASD's deficits in social orienting were not associated with poorer performance on the false belief task. As in Experiment 1, the correlations between these variables were not significant in the TD group as well. Nevertheless, there was little variability in the ToM task because it is a measure with a pass/fail outcome. Thus, the lack of correlations may be due to this lack of variability.

In Experiment 2, the relation between the two social motivation tasks in the TD group was not significant ($R^2 = 0.10$). This is probably due to a lack of power; Experiment 1 showed that the effect was significant with a larger sample size ($R^2 = 0.20$). There was no relation between the two social motivation tasks in the ASD group as well ($R^2 = 0.002$). The TD children in this experiment showed a similar pattern of social preference as in Experiment 1 (Figure 10). When TD children's performance was compared to the ASD children's performance on the biological motion task, no statistically significant between-group differences were found. Nevertheless, TD children showed a social preference on the biological motion task and, as expected, children with ASD did not show such social preference. There were no statistically significant between-group differences on the static face task. Yet, TD children preferred to orient to the social stimuli, whereas children with ASD did not show a social preference on that task as well. Furthermore, TD children preferred to orient to the social stimuli unless it was paired with an HAI object, indicating that these objects are salient for all children (Figure 11). Interestingly, both groups looked longer at the social stimuli if they were paired with LAI objects. This indicates that the HAI objects reduced children's social motivation regardless of symptomatology. The ASD group findings corroborate results found by Sasson and colleagues (2008; 2011), where the children with ASD looked less at the social images if the arrays of images presented contained HAI images. Taken together, this suggests that when there are other salient images present, children with ASD are less motivated to look at the social stimuli. As discussed above, this is also true for TD children. Nevertheless, the difference between the two group findings is that TD children displayed an overall social preference, whereas the children with ASD did not. Chevallier and colleagues (2015) discussed types of stimuli used in social preference paradigms in ASD research. They discussed the importance of using ecologically valid stimuli that are dynamic and interactive in nature in order to better capture one's social motivation. It is possible that the stimuli used in this study were not ecologically-valid enough to detect the differences in social motivation between TD children and children with ASD (between-group analyses). In Experiment 2, 63% of the subsample of TD children passed the implicit false belief task. This was not statistically significantly above chance and this is consistent with TD children's performance in the first experiment. In contrast, only 31% of the children with ASD passed this task; the difference between the TD children and the children with ASD on the implicit false belief task was a statistical trend. This suggests that despite the fact that TD children are performing at chance level, children with ASD tend to perform worse than TDs on this task.

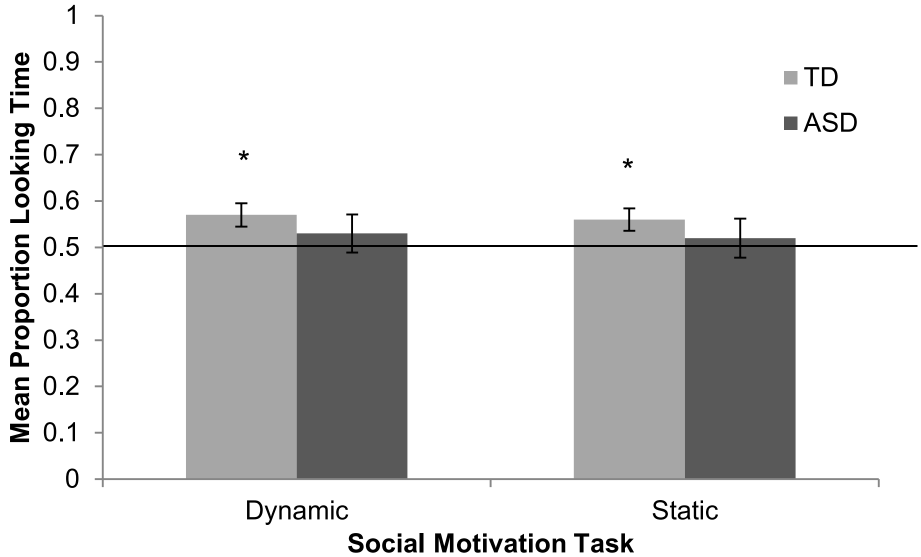

Figure 10. Proportion of looking time at the social stimuli on the social motivation tasks for TD children and children with ASD.

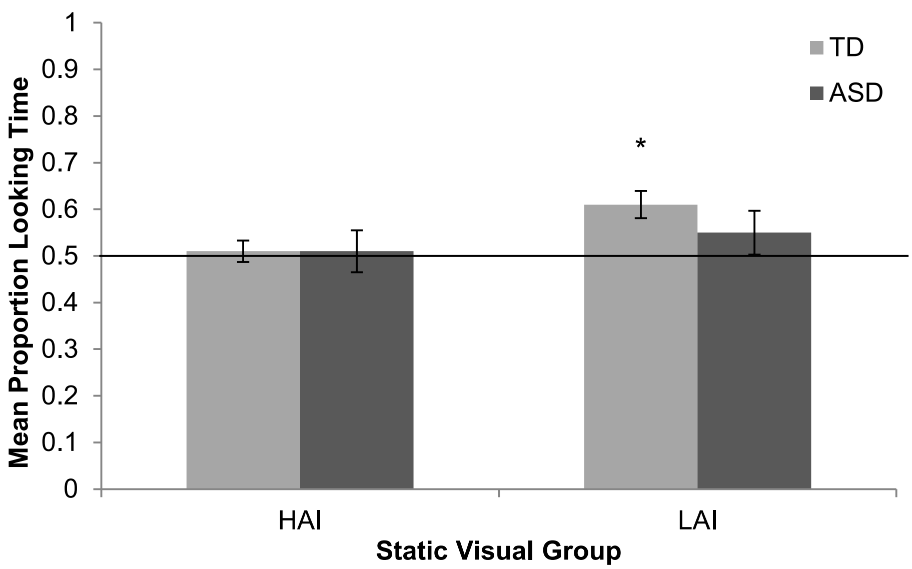

Figure 11. Proportion of looking at the social stimuli on the static face task when the social stimuli is paired with an HAI object and when it is paired with a LAI object for TD children and children with ASD.

Taken together, the ToM results are difficult to put into perspective with regards to previous research given that the TD group did not perform as expected. It is possible that methodological details of the false belief, such as the car leaving the scene, might explain these atypical results. Past studies using anticipatory looking to measure implicit false belief in young children have varied in success rate; key studies reported that between 55 and 85% of the participants correctly anticipated the protagonist's actions (Senju, et al., 2012; Southgate et al., 2007; Thoermer et al., 2012). Therefore, not all TD children will pass the implicit false belief task and this variability is typical in ToM research. The current findings show that children with ASD tended to perform worse than the TD children on the same task, indicating a deficit in ToM despite the difficulty involved in the task. This is in line with previous research on implicit or anticipatory false belief in children with ASD (Baron-Cohen et al., 1986; Kimhi, 2014; Senju, 2012; Slaughter, 2015). Some researchers have even found this to be true in adults with ASD, where the participants failed to spontaneously anticipate the protagonist's actions in a false belief task (Senju et al., 2009). For example, Schuwerk, Vuori, and Sodian (2015) demonstrated that adults diagnosed with ASD can pass some explicit false belief tasks, but they performed significantly worse than TDs on the implicit false belief tasks. In other words, the implicit and spontaneous attribution of mental states to others remains impaired in individuals with ASD from childhood to adulthood. They do perform better on the explicit version of the tasks, which is arguably due to compensations these individuals learn over the years (Frith, 2012; Senju, 2012).

Another hypothesis tested in the present study was that children would fail the naïve psychology task but succeed on the naïve physics or biology tasks. As discussed above, children with ASD did not perform better than chance on the naïve psychology task. In addition, ASD children's performance on the other two naïve theory tasks did not differ from TD children's performance. Thus, as expected, naïve physics and naïve biology appear to be developed to the same extent in both children with ASD and TD children; both groups had between 67% and 78%

correct responses on both tasks (Figure 12). Although the relation between non-verbal mental age and the naïve theory tasks was not statistically significant in the TD group, the relations were statistically significant in the ASD group. This suggests that these two tasks have a developmental trajectory in this population. These results support the hypothesis that children with ASD have a specific impairment in naïve psychology (theory of mind) but not in other naïve theories, as was previously suggested by various researchers (Baron-Cohen et al., 1986; Peterson & Siegal, 1997).

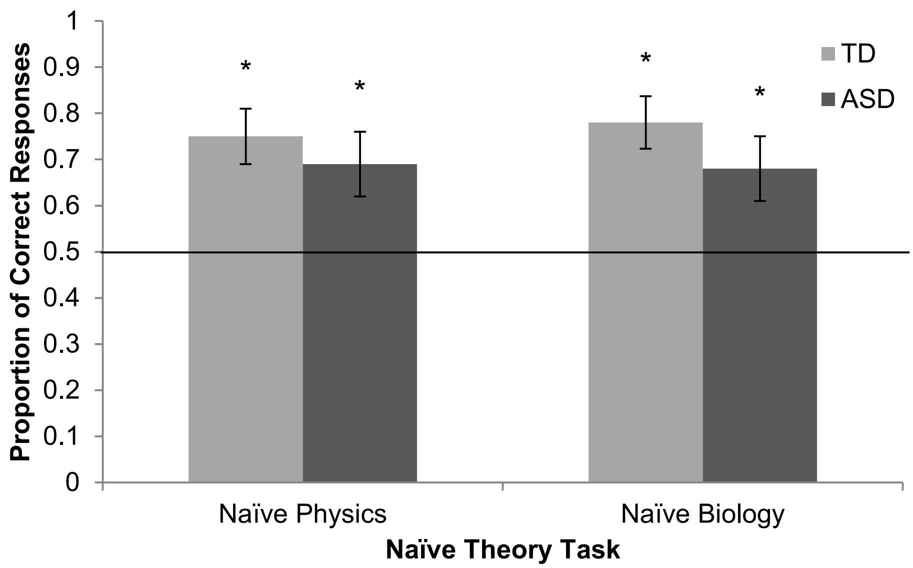

Figure 12. Proportion of correct responses on the naïve theory tasks for TD children and children with ASD.

General Discussion

One of the goals of this study was to explore the relations between the social motivation tasks. To the best of our knowledge, this is the first time that a study compares the performance of both TD children and children with ASD on these two tasks to determine whether their social orienting is consistent across modalities. Results from Experiment 1 support the hypothesis that both biological motion and static face stimuli capture similar responses from TD children as both tasks were correlated with each other. This relation was not present in Experiment 2 when children with ASD viewed the same stimuli, indicating that children with ASD do not respond consistently is social orienting paradigms. This is of importance because only one type of social stimuli is typically used in social orienting studies. Children with ASD's performance on a dynamic stimuli will not necessarily be the same as their performance on a static stimuli; this is important to note when making conclusions about children with ASD's social orienting behaviour. Furthermore, Experiment 1 served to reflect the extent to which TD children aged 3 to 6 years orient to social stimuli. This effect is robust since TD children showed a social preference on two types of modalities (i.e. static and dynamic stimuli). However, their social preference, when viewing static images, disappears when the social element is paired with a type of object previously categorized as HAI. Previous research has argued that children with ASD orient more to these objects because they are part of their circumscribed interests (Sasson et al., 2008; 2011). However, our results suggest that both TD and children with ASD prefer these objects to LAI objects. Thus, it can be argued that past (and present) results where children with ASD's lower attention to social stimuli when paired to these HAI objects might be partially driven by saliency. We therefore encourage future studies to control for saliency when comparing HAI and LAI objects. Children with ASD, as a group, did not show a social preference on either the biological motion of the static face tasks. This indicates that, notwithstanding individual variabilities across tasks, children with ASD may have deficits in social motivation.

Another goal to this study was to examine the relation between social motivation and socio-cognitive abilities in TD children and children with ASD. The purpose of this was to explore the social motivation theory in young children with ASD in order to better understand how this population's core symptomatology is related to well-known socio-cognitive deficits. In both the group comprised of TD children and the group of children with ASD, the tasks assessing social motivation were not related to the ToM task. At first glance, this lack of association does not lend support to the social motivation theory. This theory posits that the motivation to orient to social stimuli provides individuals with the opportunity to learn from said social stimuli, thus enabling the individual's socio-cognitive abilities to develop. Regardless of which concept (i.e. social motivation and ToM) causes the other, both abilities should be associated with each other. As previously mentioned, this could be due to the ToM task being based on a single trial. It is also important to note that the social motivation theory was proposed in order to explain ASD symptomatology so it is possible the association is difficult to capture in TD children given their lack of social and communication deficits. When it was assessed in the ASD group, it is possible that the effect was not found due to lack of power.

The third goal of the present study was to extend the work on the dissociation across naïve theories among children with ASD. Although it cannot be concluded that the TD children in this study passed the ToM task, children with ASD tended to perform worse than the TDs on this task, which is consistent with the past literature (Senju, 2012). Indeed, children with ASD's difficulties on ToM tasks are well documented. Yet it is still a perplexing phenomenon given the amount of variability in their abilities depending on the format in which the task is administered. Nevertheless, given individuals with ASD's overall poorer performance in ToM tasks, some theoretical perspectives suggest that this population has core deficits in naïve psychology. Baron-Cohen and colleagues (1986) proposed these core deficits after finding that their participants with ASD failed the naïve psychology task but not the naïve physics task. Results from the current study corroborate these findings. In addition, we extended previous research in showing that ASD children are also competent in naïve biology. In fact, to our knowledge this is the first study to examine all three naïve theories in the same population of children with ASD and compare them to matched controls. The TD children performed equally well on the naïve physics and naïve biology tasks but their performance on the ToM task was not statistically significantly above 50% (the criterion for passing the task). As previously discussed, this might be because ToM abilities are often related to mental state talk in the home (Ruffman, 2014). TD children findings might differ if mental state talk was controlled for in the analysis or if a standard explicit false belief task was used. Both groups had consistent performances on the naïve physics and naïve biology tasks; this partially supports the idea that children who are good at theory building would be able to do well across naïve theories. The differences arise when social and communication related skills are involved, such as in an implicit false-belief task. This discrepancy is of importance because it illustrates that children with ASD develop naïve theories and can be skilled at theory building; their core deficits stem from their social and communication symptomatology.

This study has both several strengths and limitations. Some of the limitations include small sample sizes, and the methodological aspects of the ToM task that might be responsible for the atypical performance of the TD children. When using implicit false belief tasks in preschoolers, their level of reasoning abilities should be taken into account, which may not be as relevant when studying infants. We suspect that the children might have taken a step further and expected the car to return in test trial. Future studies could include additional familiarization videos that show the children that when the car leaves the scene it does not in fact return.

An important strength of this study is its attempt to integrate a number of variables in order to fully capture the concept of social motivation. For example, rather than studying social motivation in isolation, this study included a ToM task along with two social orienting tasks in order to directly test the social motivation theory. Furthermore, rather than looking solely at children with ASD's core deficits in naïve psychology, other naïve theories were included to get a detailed understanding of the role of various domain-specific knowledge tasks in both groups. The authors also recognize the value of replication in research. The current study either included several tasks used in previous studies or adapted previously used methodologies in order to extend on the existing literature. Results in the present study replicate and extend previous findings and strengthen the understanding of ASD symptomatology and its limits.

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Concordia University

Dear Parents,

April 2015

The Cognitive and Language Development Laboratory, part of the Centre for Research and Human Development at Concordia University, is presently involved in a study examining social development in typically-developing children and children with Autism Spectrum Disorder. This research project is being carried out in collaboration with Dr. Mayada Elsabbagh and Dr. Laura Stern at the Montreal Children's Hospital. We therefore invite you to participate in one of our new studies and have the unique experience of learning more about your child and child development, as well as contributing to research in this field!

Our research has been funded by federal and provincial agencies for the past twenty-five years and our team is internationally recognized for its excellent work in child development. Our articles are frequently published in journals such as "Developmental Science" and "Research in Autism Spectrum Disorders." You might also have heard about our studies on national radio or on the *Discovery Channel*.

For the present study, your child will have the opportunity to participate in a few short games. During these games, child-friendly images and videos will be shown **on a computer screen** and we will record what your child is interested in. Your child will **also play with picture cards** during interactive games with the experimenter. Your child will also participate in a brief assessment of language comprehension and ability to solve puzzles. We will videotape you child's behaviour including looking time at videos and all tapes will be treated as strictly confidential.

Overall, your participation will involve two approximately 60-minute-long visits to our laboratory at the Loyola Campus of Concordia University, located at 7141 Sherbrooke Street West, in Notre-Dame-de-Grace. Appointments can be scheduled at a time that is convenient for you and your child, including weekends. Free parking is available on the campus and we offer babysitting for siblings who come to the appointment. Upon completion of the study, a Certificate of Merit for Contribution to Science will be given to your child, and you will be offered financial compensation **of $25 each session for a total of $50** for your participation. A summary of the results of our study will be mailed to you once the study is completed.

For the purposes of this study, we are looking for typically-developing children and children with Autism Spectrum Disorder who are between 3 and 6 years of age, who have English or French as a first language, and who do not have any visual or hearing difficulties. If you are interested in having your child participate in this study, or would like any further information, please contact Kimberly Burnside or Josée-Anne Bécotte at (514) 848-2424 ext. 2279. For more information on our studies, please visit our website at http://crdh.concordia.ca/dpdlab/. We will try to contact you by telephone within a few days of receiving this letter.

We are looking forward to speaking with you in the near future.

Sincerely yours,

Diane Poulin-Dubois, Ph.D.	Kimberly Burnside, B.A.	Kristyn Wright, M.A.
Professor	M.A. Clinical Psychology Student	Ph.D. Clinical Psychology Student
Department of Psychology	Department of Psychology	Department of Psychology

UNIVERSITÉ Concordia UNIVERSITY

Avril 2015

Chers parents,

Le Laboratoire de Recherche sur le Développement de la Cognition et du Langage, qui fait partie du Centre de Recherche sur le Développement Humain de l'Université Concordia, effectue présentement une étude qui examine le développement sociale chez les enfants atteints de troubles du spectre autistique. Cette recherche est effectuée en collaboration avec Dr. Mayada Elsabbagh et Dr. Laura Stern de l'hôpital de Montréal pour enfants. Nous vous invitons donc à vivre l'expérience unique d'en apprendre davantage sur votre enfant et sur le développement des enfants, ainsi que de contribuer à la recherche dans ce domaine!

Nos recherches sont subventionnées depuis près de 25 ans par des organismes fédéraux et provinciaux, et notre équipe de recherche est internationalement reconnue pour son excellent travail sur le développement des jeunes enfants. Nos articles sont souvent publiés dans des revues prestigieuses telles que «Developmental Science» et «Research in Autism Spectrum Disorders». Vous avez peut-être aussi entendu parler de nos études à la radio ou sur la chaîne de télévision *«Discovery Health Channel»*.

Dans la présente étude, votre enfant sera invité à participer à quelques jeux. Ces jeux consistent a présenter des images et des vidéos adaptés aux enfants sur un écran d'ordinateur pendant que nous mesurons le regard de votre enfant pour déterminer ce qui l'intéresse. Votre enfant **jouera aussi avec des cartes affichant différentes images** lors d'un jeu interactif avec l'expérimentatrice. De plus, votre enfant participera à une brève évaluation de sa compréhension verbale et de son habileté à résoudre des casse-têtes. Les réactions de votre enfant seront filmées, notamment l'endroit où il regardera lors de la vidéo, et toutes les informations recueillies ainsi que les enregistrements seront traités de façon strictement confidentielle.

Dans l'ensemble, votre participation comportera deux visites d'environ 60 minutes à notre centre de recherche situé sur le campus Loyola de l'Université Concordia, au 7141 rue Sherbrooke Ouest, dans le quartier Notre-Dame-de-Grâce. Vous pourrez prendre rendez-vous au moment qui vous conviendra le mieux, y compris pendant les fins de semaine. Le stationnement sur le campus est gratuit et nous offrons un service de garde pour les frères et sœurs qui viennent au rendez-vous. Lors que votre participation à l'étude sera complétée, un Certificat de Mérite pour la Contribution à la Science sera remis à votre enfant, et vous recevrez une compensation financière de **$50** pour votre participation aux deux visites. Un résumé des résultats vous sera envoyé dès que l'étude sera complétée.

Pour cette étude, nous recherchons des enfants qui sont atteints de troubles du spectre autistique âgés entre 3 et 6 ans, qui ont le français ou l'anglais comme langue maternelle et qui n'ont aucun problème auditif ou visuel. Si vous désirez que votre enfant participe à cette étude ou si vous désirez obtenir de plus amples informations, veuillez contacter Kimberly Burnside ou Josée-Anne Bécotte au (514) 848-2424 poste 2279.

Pour plus d'informations sur nos études, vous pouvez visiter notre site internet au http://crdh.concordia.ca/dpdlab/. Nous tenterons de vous rejoindre par téléphone quelques jours après la réception de cette lettre.

Recevez l'expression de nos sentiments distingués,

Diane Poulin-Dubois, Ph.D.
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Département de Psychologie
Université Concordia

Kimberly Burnside, B.SC.
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Parental Consent Form

This is to state that I understand that I have been asked if my child can participate in a research project conducted by Dr. Diane Poulin-Dubois and graduate students Kristyn Wright and Kimberly Burnside of Concordia University in collaboration with Dr. Mayada Elsabbagh and Dr. Laura Stern of the Montreal Children's Hospital.

A. PURPOSE

I have been informed that the purpose of the research is to examine social motivation and theory of mind in typically developing children and children with Autism Spectrum Disorder (ASD).

B. PROCEDURES

For the present study, you will be asked to complete a few short questionnaires about your child's interests and social behavior. Your child will participate in two sessions where he or she will view three short videos and will participate in interactive tasks both on the computer and with a female researcher. A camera will monitor the eye movement of your child on the screen. Videos consist of child-friendly clips and images of objects and humans. Your child will also play a computer game where he or she will be asked to press buttons on a touch-screen computer to hear different sounds. Your child will also participate in an evaluation of his or her understanding of simple language as well as a task requiring to solve visual puzzles.

We will videotape your child's responses and all tapes will be treated in the strictest of confidentiality. That means that the researcher will not reveal your child's identity in any written or oral reports about the study. You and your child will be assigned a coded number, and that code will be used on all materials collected in this study. All materials and data will be stored in secure facilities in the Department of Psychology at Concordia University. Only members of the research team will have access to these facilities. Questionnaires and electronic data files will be identified by coded identification numbers, unique to each family. Information collected on paper (questionnaires) or videotapes (observed behaviours) will be entered into computer databases. Raw data will be kept for a minimum of 5 years. When it is time for disposal, papers will be shredded, hard-drives will be purged, and videotapes and computer disks will be magnetically erased. Additionally, since we are only interested in comparing children's understanding as a function of age, no individual scores will be provided following participation. Each session should last approximately 75 minutes.

C. RISKS AND BENEFITS

Your child will be given a certificate of merit at the end of the session as a thank-you for his/her participation. Also, you will be offered 50$ for your participation ($25 per visit).

There is one condition which may result in the researchers being required to break the confidentiality of your child's participation. There are no procedures in this investigation that inquire about child maltreatment directly. However, by the laws of Québec and Canada, if the researchers discover information that indicates the possibility of child maltreatment, or that your child is at risk for imminent harm, they are required to disclose this information to the appropriate agencies. If this concern emerges, the lead researcher, Dr. Diane Poulin-Dubois, will discuss the reasons for this concern with you and will advise you of what steps will have to be taken.

D. CONDITIONS OF PARTICIPATION

- I understand that I am free to withdraw my consent and discontinue my participation at any time without negative consequences, including the loss of financial compensation.
- I understand that the experimenter will gladly answer any questions that might arise during the course of the research.
- I understand that my participation in this study is confidential (i.e. the researchers will know, but will not disclose my identity).
- I understand that the data from this study may be published, though no individual scores will be reported.

I would be interested in participating in other studies with my child in the future (yes/no): ______

I HAVE CAREFULLY STUDIED THE ABOVE AND UNDERSTAND THIS AGREEMENT. I FREELY CONSENT AND VOUNTARILY AGREE TO HAVE MY CHILD PARTICIPATE IN THIS STUDY.

MY CHILD'S NAME (please print) ______________________________

MY NAME (please print) ______________________________

SIGNATURE ______________________ DATE ______________

WITNESSED BY ______________________ DATE ______________

If at any time you have questions about your rights as a research participant, you are free to contact the Research Ethics and Compliance Officer of Concordia University, at (514) 848-2424 ext 7481 or by email at ethics@alcor.concordia.ca.

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Participant # ____________ Researcher: ______________

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Formulaire de consentement des parents

Je déclare avoir compris que l'on m'a demandé si mon enfant pouvait participer à un projet de recherche mené par la Dre. Diane Poulin-Dubois, la doctorante Kristyn Wright et l'étudiante à la maîtrise Kimberly Burnside en collaboration avec les Dre. Mayada Elsabbagh et Dre. Lara Stern de l'hôpital pour enfants de Montréal.

A) BUT

J'ai pris connaissance du but de la présente étude qui est d'examiner la motivation sociale et la théorie de l'esprit auprès d'enfants au développement typique et d'enfants avec un trouble spectral de l'autisme (TSA).

B) PROCÉDURE

La présente étude requiert que vous complétiez quelques brefs questionnaires concernant le vocabulaire et le comportement social de votre enfant. Votre enfant participera à <u>deux</u> sessions où il ou elle visionnera trois courtes vidéos, et participera ensuite à des tâches interactives sur un ordinateur avec une expérimentatrice. Une caméra enregistrera les mouvements oculaires de votre enfant vers l'écran. Chaque vidéo présente des images adaptées aux enfants ainsi que des images d'objets et d'humains. Votre enfant jouera aussi à un jeu qui consiste à appuyer sur des boutons sur un écran tactile afin d'entendre divers sons. Votre enfant participera par la suite à une évaluation de ses connaissances linguistiques et de son habileté à résoudre des casse-têtes.

Nous enregistrerons sur bande vidéo les réponses de votre enfant, et toutes les vidéos seront traitées avec la confidentialité la plus stricte. Cela signifie que la chercheuse ne dévoilera pas l'identité de votre enfant, dans tout rapport sur l'étude, que ce soit oral ou écrit. Vous et votre enfant recevrez un code à chiffres, qui sera utilisé tout au long de la collecte des données. Toutes les données et tout le matériel seront conservés dans un endroit sécuritaire du département de psychologie de l'Université Concordia. Seuls les membres de l'équipe de recherche auront accès à cet endroit. Les questionnaires et les données électroniques seront identifiés par un code à chiffres, propre à chaque famille. Les informations recueillies sur papier (questionnaires) ou sur vidéocassettes (comportement observé) seront entrées dans une base de données informatique. Les données brutes seront conservées pendant une période minimum de 5 ans. Lorsqu'il sera temps d'en disposer, les papiers seront déchiquetés, les unités de disques durs nettoyés, et le contenu des vidéocassettes ainsi que des disques d'ordinateur seront effacés. De plus, puisque nous ne sommes intéressées qu'à comparer la compréhension des enfants en fonction de leur âge, aucune donnée individuelle ne sera fournie à la suite de votre participation. Chaque session devrait durer approximativement 75 minutes.

C) RISQUES ET AVANTAGES

Votre enfant recevra un certificat de mérite à la fin de la session pour le remercier d'avoir participé. Vous recevrez aussi 50$ de compensation pour votre participation (25$ par visite).

Il y a une condition qui pourrait donner lieu aux chercheurs d'être dans l'obligation de briser la confidentialité de la participation de votre enfant. Il n'y a pas de procédures dans cette étude qui demandent des renseignements sur la maltraitance des enfants directement. Par contre, suite aux lois du Québec et du Canada, si les chercheurs découvrent de l'information qui indique la possibilité de maltraitance, ou que votre enfant soit à risque de danger immédiat, les chercheurs sont dans l'obligation de divulguer cette information aux agences appropriées. Si cette situation surgis, la chercheure principale, Dre. Diane Poulin-Dubois, discutera avec vous et vous informera des mesures qui devront être prises.

D) CONDITIONS DE PARTICIPATION

- Je comprends que je suis libre de retirer mon consentement et de mettre fin à ma participation à tout moment sans la moindre conséquence négative ni perte de compensation financière.
- Je comprends que l'expérimentatrice se fera un plaisir de répondre à toute question que je pourrais avoir à tout moment au cours de l'étude.
- Je comprends que ma participation à l'étude est confidentielle (c'est-à-dire que la chercheuse connaîtra mais ne dévoilera pas mon identité).
- Je comprends que les données de cette étude pourront être publiées, mais qu'aucune donnée individuelle ne sera divulguée.

Je serais intéressé(e) à être contacté(e) de nouveau pour participer avec mon enfant à de futures études menées par le Centre de Recherche en Développement humain (OUI/ NON):_________

J'AI LU ATTENTIVEMENT L'INFORMATION PRÉCÉDENTE ET COMPREND CETTE ENTENTE. JE CONSENS LIBREMENT ET VOLONTAIREMENT À CE QUE MON ENFANT PARTICIPE À CETTE ÉTUDE.

NOM DE MON ENFANT (imprimer s'il-vous-plait) ______________________________

MON NOM (imprimer s'il-vous-plait) ____

SIGNATURE __________________________ DATE ____________________________

SIGNÉ EN PRESENCE DE ________________DATE______________________________

Si vous avez des questions à propos de vos droits comme participant à la recherche, veuillez contacter la Conseillère sur l'éthique en recherche de l'Université Concordia, au (514) 848-2424 ext. 7481 ou par courriel à l'adresse ethics@alcor.concordia.ca.

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No. De Participant ___________ Chercheur: ________________

Demographic Information ***Participant Number:*** ____

Relationship of yourself to person participating in the study (hereafter called 'participant'):

1. Self
2. Parent
3. Guardian
4. Other (please explain)________________________________

Date of birth of the participant: ______________________
(dd)/(mm)/(year)

Address (including **postal code**):
____
____

Phone numbers	**Where?** (e.g. home, Mom work, Dad cell)
1.	
2.	
3.	
4.	

E-mail: ____________________________________

Family and Child Background Information

Who else lives in the home with the participant?

Relationship to the participant	Age	Gender	Diagnosis, if any

Is English the first language of the participant? ☐ **Yes** ☐ **No**

Does the participant speak any other languages? ☐ **Yes** ☐ **No**

Does the participant live at home with his/her parent(s)? ☐ **Yes** ☐ **No**

If not, what are the participant's living arrangements?

1. Group Home
2. Independently
3. With other family members
4. Other (please explain)____

If the participant is living at home, what is the marital status of the parent(s) s/he is living with?

1. Married	2. Divorced
3. Separated	4. Common-law
5. Remarried	6. Widowed
7. Single	8. Other

Parent A's Current Level of Education
Check any/all that apply:

- ☐ Primary School
- ☐ Some High School
- ☐ High School
- ☐ Some College/University
- ☐ College Certificate/Diploma
- ☐ Trade School Diploma
- ☐ Bachelor's Degree
- ☐ Master's Degree
- ☐ Doctoral Degree
- ☐ Professional Degree
- ☐ Not Applicable/Unknown
- ☐ Other (please specify):
  ____
  ____

Parent B's Current Level of Education
Check any/all that apply:

- ☐ Primary School
- ☐ Some High School
- ☐ High School
- ☐ Some College/University
- ☐ College Certificate/Diploma
- ☐ Trade School Diploma
- ☐ Bachelor's Degree
- ☐ Master's Degree
- ☐ Doctoral Degree
- ☐ Professional Degree
- ☐ Not Applicable/Unknown
- ☐ Other (please specify):
  ____
  ____

In which of the following ranges does your annual household income fall?

- ☐ < $22 000
- ☐ Between $22 000 and $35 000
- ☐ Between $35 000 and $50 000
- ☐ Between $50 000 and $75 000
- ☐ Between $75 000 and $100 000
- ☐ Between $100 000 and $150 000
- ☐ > $150 000

Is there any history of autism spectrum disorder in your immediate family? ☐ **Yes** ☐ **No**
If yes, please explain____

Is there any history of autism spectrum disorder in your extended family? ☐ **Yes** ☐ **No**
If yes, please explain____

Is there any history of language or reading problems in your immediate family? ☐ **Yes** ☐ **No**
If yes, please explain____

Is there any history of psychiatric disorders in your immediate/extended family? ☐ **Yes** ☐ **No**
If yes, please explain____

Did the participant experience seizures, head trauma or serious illness? ☐ **Yes** ☐ **No**
If yes, please explain____

Health History

Parent A age: ____________ Parent B age: ____________

What was your child's birth weight? __ __ **lbs** __ __ **oz** OR __ __ __ __ **grams**
How many weeks was your pregnancy? ____________**weeks**

Were there any **complications** during the pregnancy? ☐ **Yes** ☐ **No**
If yes please detail ____

Has your child had any major **medical problems**?
If yes please detail____

Does your child have any **hearing or vision problems**?
If yes please detail____

Does your child **currently** have an ear infection? ☐ **Yes** ☐ **No**

Developmental History

What is the participant's diagnosis, if any? ____

Does the participant carry any secondary diagnosis, and if so, what is it?

____

At what age was the participant diagnosed? ____

Who diagnosed the participant?____

Has the diagnosis ever been called into question? Yes No
If yes, please explain.____

____

Has the participant ever been in treatment (e.g., early intervention)? ☐ **Yes** ☐ **No**

If yes, please fill out the table below for <u>each</u> type of treatment: e.g., ABA, speech, OT,

Treatment Type	Began	Ended (if discontinued)	Number of hours per week?

What is the participant's school day like?

- € S/he is mainstreamed without any extra help
- € S/he is mainstreamed and shares an aide with one or more other children
- € S/he is mainstreamed and has his/her own educational aide
- € S/he is mainstreamed for some classes (e.g. music, phys ed), but is in a special needs classroom for most academic subjects
- € S/he is in a special needs classroom all day
- € S/he is in a classroom for children with emotional/behavioural difficulties
- € Other (please explain)________________________________

Does your child have any special interests (i.e. more intense than most children his/her age) Y N

If yes, what are they? ____

____

Is your child particularly interested in any of the following (check all that apply):

- € Machines
- € Furniture
- € Vehicles
- € Instruments
- € Plants
- € Letters & numbers
- € Blocks
- € Tools
- € Kitchen supplies
- € Road signs
- € Clothing
- € Electronics
- € Clocks

Has your child ever used a touch-screen (i.e. iPad) before? ☐ **Yes** ☐ **No**
How often does your child have access to touch-screen devices:

1	2	3	4	5
Never		Sometimes		Often

Information sur le participant ***Numéro du participant : ______***

Votre relation avec la personne qui participe à cette étude (ci-après dénommé « participant »)

1. Soi-même
2. Parent
3. Tuteur
4. Autre (svp spécifier) ________________________________

Date de naissance de l'enfant: ________________
MM / JJ / AA

Adresse (s'il vous plait, inclure le **code postal**) :

____

____

Numéros de téléphone	**Où?** (p. ex. maison, travail mère, cellulaire père)
1.	
2.	
3.	
4.	

Courriel : ____________________________________

Information sur l'enfant et sa famille

Qui d'autre habite dans la même maison que le/la participant(e)?

Lien avec le/la participant(e)	Âge	Sexe	Diagnostic, s'il y en a

Est-ce le français la langue maternelle du participant? ☐ **Oui** ☐ **Non**

Est-ce que le participant parle d'autres langues? ☐ **Oui** ☐ **Non**

Est-ce que le participant habite avec son/ses parents(s) ☐ **Oui** ☐ **Non**

Sinon, où habite le participant?

1. Foyer de jeunesse
2. Seul(e)
3. Avec d'autres membres de la famille
4. Autre (svp spécifier) ______________________

Si le participant habite à la maison, quel est le statut d'état civile du/des parent(s) ?

1. Marié(e)
2. Séparé(e)
3. Remarié(e)
4. Célibataire
5. Divorcé(e)
6. Conjoint(e) de fait
7. Veuf/Veuve
8. Autre

Éducation du Parent A

Veuillez indiquer tout ce qui s'applique à ce jour :

- ☐ École primaire
- ☐ Études secondaires (non complétées)
- ☐ Diplôme d'études secondaires (DES)
- ☐ Études collégiales/universitaires (non complétées)
- ☐ Certificat/diplôme collégial (DEC)
- ☐ Attestation d'études collégiales (AEC)
- ☐ Baccalauréat
- ☐ Maîtrise
- ☐ Doctorat
- ☐ Diplôme d'études professionnelles (DEP)
- ☐ Ne s'applique pas/je ne sais pas
- ☐ Autre (s'il vous plaît, veuillez spécifier) :

____

Éducation du Parent B

Veuillez indiquer tout ce qui s'applique à ce jour :

- ☐ École primaire
- ☐ Études secondaires (non complétées)
- ☐ Diplôme d'études secondaires (DES)
- ☐ Études collégiales/universitaires (non complétés)
- ☐ Certificat/diplôme collégial (DEC)
- ☐ Attestation d'études collégiales (AEC)
- ☐ Baccalauréat
- ☐ Maîtrise
- ☐ Doctorat
- ☐ Diplôme d'études professionnelles (DEP)
- ☐ Ne s'applique pas/je ne sais pas
- ☐ Autre (s'il vous plaît, veuillez spécifier) :

____

Tranche de revenus pour l'ensemble du ménage par année :

- ☐ 22,000$ et moins
- ☐ Entre 22,000$ et 35,000$
- ☐ Entre 35,000$ et 50,000$
- ☐ Entre 50,000$ et 75,000$
- ☐ Entre 75,000$ et 100,000$
- ☐ Entre 100,000$ et 150,000$
- ☐ 150,001$ et plus

Est-ce qu'il y a des antécédents de troubles du spectre autistique dans votre famille immédiate?

☐ **Oui** ☐ **Non** Si oui, expliquez s'il vous plaît ______________________

Est-ce qu'il y a des antécédents de troubles du spectre autistique dans votre famille éloignée?

☐ **Oui** ☐ **Non** Si oui, expliquez s'il vous plaît ______________________

Est-ce qu'il y a des antécédents de troubles du langage ou de lecture dans votre famille immédiate ou éloignée?

☐ **Oui** ☐ **Non** Si oui, expliquez s'il vous plaît ______________________

Est-ce qu'il y a des antécédents de troubles psychiatriques dans votre famille immédiate ou éloignée?

☐ **Oui** ☐ **Non** Si oui, expliquez s'il vous plaît ______________________________

Est-ce que le/la participant(e) a eu des crises d'épilepsie, infections aux oreilles, traumatisme crânien ou maladie grave lorsqu'il/elle était plus jeune ?

☐ **Oui** ☐ **Non** Si oui, expliquez s'il vous plaît ______________________________

Information générale sur la santé de votre enfant

Age du Parent A : __________ Age du Parent B : __________

Quel était le poids de votre enfant à sa naissance? __ __ **lb** __ __ **oz** OU __ __ __ __ **g**

Combien de semaines votre grossesse a-t-elle duré? __________**semaines**

Y a-t-il eu des **complications** durant la grossesse? ☐ **Oui** ☐ **Non**
Si oui, s'il-vous-plaît veuillez préciser ______________________________

Votre enfant a-t-il déjà souffert de **problèmes médicaux** majeurs?
Si oui, s'il-vous-plaît veuillez préciser ______________________________

Votre enfant a-t-il des **problèmes auditifs ou** visuels?
Si oui, s'il-vous-plaît veuillez préciser ______________________________

Est-ce que votre enfant a **actuellement** une infection aux oreilles? ☐ **Oui** ☐ **Non**

Information générale sur le développement de votre enfant

Quel est le diagnostic du participant, s'il y en a?

____

Est-ce que le participant a un diagnostic secondaire? Si oui, lequel ?

____

À quel âge le/la participant(e) a-t-il été diagnostiqué(e)? ____________________

Qui a diagnostiqué le/la participant(e)? ______________________________

Est-ce que le diagnostic a déjà été remis en cause? Oui Non
Si oui, expliquez s'il vous plaît.

____

____

Est-ce que le participant a déjà été en traitement (ex. : intervention précoce)? ☐ **Oui** ☐ **Non**

Si oui, s'il vous plaît remplir les cases ci-bas pour chaque type de traitement : ex. : AGA, orthophonie

Type de traitement	Date de début	Date de fin (si discontinué)	Nombre d'heures par semaine

En quoi consiste une journée typique à l'école?

- ☐ Il/elle est intégré (?) sans aide supplémentaire.
- ☐ Il/elle est intégré (?) et partage une aide avec un ou plusieurs enfants.
- ☐ Il/elle est intégré et possède sa propre aide éducationnelle.
- ☐ Il/elle est intégré pour certains cours (par exemple musique, éducation physique), mais est dans une classe spécialisée pour le reste des cours.
- ☐ Il/elle est dans une classe spécialisée toute la journée
- ☐ Il/elle est dans une classe pour enfants avec des difficultés émotionnelles/comportementales
- ☐ Autre (expliquez s'il vous plaît) ____

Est-ce que le participant a des intérêts spéciaux (plus intense que la plupart des enfants de son âge)?
☐ **Oui** ☐ **Non**

Si oui, quels sont-ils? ____

____

Est-ce que le participant est particulièrement intéressé(e) par les items suivants?
(Cocher ceux qui s'appliquent)

- ☐ Machines
- ☐ Meubles
- ☐ Véhicules
- ☐ Instruments de musique
- ☐ Plantes
- ☐ Lettres & numéros
- ☐ Blocs
- ☐ Outils
- ☐ Articles de cuisine
- ☐ Panneaux de signalisation routière
- ☐ Vêtements
- ☐ Appareil électroniques
- ☐ Horloges

Est-ce que le participant a déjà utilisé un écran tactile (ex. : iPad) ? ☐ **Oui** ☐ **Non**
À quelle fréquence le participant a-t-il accès à un appareil avec écran tactile?

1	2	3	4	5
Jamais		Parfois		Souvent