OVER-IMITATION IN CHILDREN WITH AUTISM SPECTRUM DISORDER: A CONSIDERATION OF THEORETICAL UNDERPINNINGS AND CORRELATES

by

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Abstract

Over-imitation is the imitation of actions that are causally unnecessary to achieve a target outcome. Researchers have found that children with ASD will reproduce modelled actions that are not causally necessary for achieving the goal of an apparatus-directed task (e.g., to retrieve an object from within an apparatus). A three phase experimental design (Study 1) was used to investigate whether social or non-social theories of over-imitation would explain such behaviour in a sample of children with autism spectrum disorder (ASD: n = 26, 20 males, mean age 10.15 years) and a sample of typically developing children (TDC: n = 26, 19 males, mean age 9.35 years). All participants observed models manipulate apparatuses using unnecessary and necessary actions to retrieve an object. Questionnaires completed by parents, and a standardized assessment measure given to participants, were used to gather information about social functioning, communication, and cognitive ability. Preliminary results suggested that order of presentation might be a factor in determining children's responses; therefore, a second condition, varying order of presentation of tasks, as well as a second study (Study 2), was introduced to further examine these unanticipated results. Contrary to hypotheses, neither study supported a non-social theory of over-imitation for children with ASD. No group differences were found. Instead, order of presentations of apparatuses was the only variable to have a significant relationship with over-imitation; there was no relationship between social functioning, communication, or nonverbal cognition and over-imitation. These findings appear to support a theory of over-imitation that attributes the behaviour to normative learning and, more specifically, suggest that children with ASD were sensitive to the context in which the tasks were presented. Implications for

understanding over-imitation in children with ASD, project strengths and weaknesses, and directions for future research are discussed.

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Chapter 1

Overview

Autism Spectrum Disorder (ASD) is a neurodevelopmental condition characterized by core deficits in social interaction and communication as well as restricted, stereotyped, and repetitive behaviours and interests (American Psychiatric Association, 2013; Elsabbagh et al., 2012). Deficits in social interaction and communication include deficits in social-emotional reciprocity, as exhibited by atypical social approach, including failure to initiate or respond to social interaction, and reduced sharing of interests or emotion (APA, 2013). Difficulties in social attention may lie in disproportionate visual attention to non-social objects relative to social stimuli (Elison, Sasson, Turner-Brown, Dichter, & Bodfish, 2012; Bauminger-Zviely, 2014). Many individuals with autism have language deficits and existent language may be one-sided and used only for request or labelling (APA, 2013); there are often inadequate conversation skills (Volkmar, Reichow, Westphal, & Mandell, 2014). In regards to non-verbal communication, there may be limited eye contact, abnormalities in body language, and limited range and appropriateness of facial expression (APA, 2013; Volkmar et al., 2014). Restricted and repetitive behaviour, interests, or activities is the second major deficit in ASD (APA, 2013). These include stereotyped or repetitive movements, insistence on sameness, routine, or ritualized patterns, and restricted or fixated interests. These behaviours tend to interfere with daily functioning and span all developmental and functional levels (Volkmar et al., 2014). According to recent epidemiological studies, prevalence rates for ASD appear to be on the rise, with current estimates of 1 in 68 of children in the United States (Centre for Disease Control and

Prevention, 2014) and 62/10 000 children globally being affected (Elsabbagh et al., 2012). ASD occurs in all racial, ethnic, and socioeconomic groups and is 5 times more common among boys than girls (Centre for Disease Control and Prevention, 2014).

Our understanding of ASD has evolved over time with increased research and clinical interest and, consequently, the definition has broadened. Kanner's clinical description and use of the term autism first appeared in the third edition of the Diagnostic and Statistical Manual (DSM) in 1980 within the class of Pervasive Developmental Disorders. Before that, autism was considered a form of childhood onset schizophrenia (Volkmar et al., 2014). When autism was introduced into DSM-III, the criteria specified deficits in social skills and communication alongside a pattern of restricted behaviours and repetitive interests. Three disorders were outlined under the umbrella of pervasive developmental disorder (infantile autism, childhood onset pervasive developmental disorder, and atypical pervasive developmental disorder). With the fourth edition, including DSM-IV in 1994 and DSM-IV-TR in 2000, five distinct pervasive developmental disorders were outlined (i.e., autistic disorder, Asperger's syndrome, Rett's disorder, childhood disintegrative disorder, and pervasive developmental disorder, not otherwise specified). In 2013, DSM-5 brought a shift to one overarching category of Autism Spectrum Disorder. The original symptom triad of social, communication, and behavioural deficits was reconfigured into a dyad, with the social and communication symptoms combined into one criterion of deficits in social-communication and the restricted, repetitive patterns of behaviour as the second criterion. Severity of impairment can be specified based on the level of support required

for the two criteria, and presence or absence of intellectual or language impairment can be noted (APA, 2013).

Research has expanded the understanding of deficits associated with ASD beyond the core criteria. We now know that children with ASD may display difficulties with executive functioning, including cognitive flexibility, planning, and problem solving (Bauminger-Zviely, 2014). Adaptive behaviour is often impaired, including difficulty with planning, organizing, and coping with change (Bauminger-Zviely, 2014). Theory of mind deficits (the understanding that others have desires, thoughts and beliefs different from one's own) are often present (Kimhi, 2014). Inadequate play skills are often found in children with ASD, particularly when the play does not have structure or rules (Bauminger-Zviely, 2014; Macintosh & Dissanayake, 2006). There are also possible comorbid conditions. Hyperactivity, affective symptoms, tics, and self-injury have been reported to co-occur with ASD (Bauminger-Zviely, 2014). Cognitive ability has been found to vary with children with ASD. Children diagnosed with ASD are often described as high functioning or low functioning depending on the extent of their cognitive limitations. With regards to school-age children (the target age group for this study) with ASD, approximately 40-50% have co-occurring intellectual deficits, with some evidence suggesting greater deficits in verbal skills than non-verbal skills (Bauminger-Zviely, 2014).

Research also suggests children with ASD experience imitation deficits. In particular, children with ASD appear to perform more poorly on gestural imitation compared to their typically developing counterparts (Mostofsky et al., 2006) while object-directed imitation seems to be relatively spared in children with ASD (DeMeyer

et al., 1972; Hammes & Langdell, 1981; Hobson & Lee, 1999; Williams, Whiten & Singh, 2004). Children with ASD perform better on object-directed tasks that involve the imitation of meaningful/functional actions than those that involve non-meaningful/functional actions (Rogers, Young, Cooks, Giolzetti, & Ozonoff, 2010). This pattern of imitation behaviour can be considered within the functions of imitation. The cognitive-apprenticeship function of imitation involves the imitation of functional, goal-directed actions whereas the social-communicative function of imitation is based on a desire to connect with the person and communicate a shared understanding (Uzgiris, 1981). The imitation behaviour of children with ASD is more likely to serve a cognitive-apprenticeship function of imitation versus a social function.

A relatively new area of imitation being researched in children with ASD is over-imitation. Over-imitation is defined as the imitation of actions that are not causally necessary to achieve a target outcome (Lyons, Young, & Keil, 2007). In the typical over-imitation task, a model demonstrates the opening of a box-like apparatus that contains an object. The model first uses a handheld "tool" to intentionally make an action on a part of the apparatus that is not located near the opening mechanism (i.e., irrelevant action). The model then uses the tool to intentionally manipulate the opening mechanism (i.e., related action). Participants are then presented with both the tool and apparatus and given the opportunity to retrieve the object themselves. The reproduction by participants of the causally irrelevant actions on the apparatus when a more efficient method is available is dubbed over-imitation (Lyons et al., 2007). Research has suggested that TD children over-imitate because of a desire to affiliate with, or be like, the model (Nielsen & Blank, 2011). Initial exploration of over-imitation in children with

ASD was done as an attempt to rule out a social explanation for the behaviour. Because evidence suggests children with ASD imitate for functional, rather than social-communicative reasons, they were not expected to imitate the irrelevant action (Nielsen & Hudry, 2010). Contrary to expectation, children with ASD did include the irrelevant action and did so to the same extent as typically developing peers and peers with Down Syndrome (Nielsen & Hudry, 2010). They also used the tool to make the causally related action when they could have used their hands. Thus, not only did they include the unnecessary, irrelevant action when manipulating the apparatus, they performed actions that were not functionally necessary to complete the task (Nielsen & Hudry, 2010).

One possible explanation for over-imitation by children with ASD is that the behaviour is the result of a mistaken belief about the causality of the irrelevant action. Initial studies of over-imitation with children with ASD used novel opaque apparatuses. The use of opaque apparatuses may have made it difficult for children to determine the causal necessity of the irrelevant actions. This may have led to the children with ASD believing that the irrelevant actions were causal. Another possibility is that the use of novel objects may have led children with ASD to treat the tasks like object learning tasks. That is, the over-imitation tasks may have tapped into the cognitive-apprenticeship function rather than the social-apprenticeship function. One study examined over-imitation using familiar objects. The authors reasoned that, with familiar objects, the children would know that the actions were irrelevant; therefore, over-imitation would not be due to a mistaken causal belief. Rather, this would suggest that the over-imitation was socially motivated (Marsh, Pearson, Ropar, & Hamilton, 2013).

While children with ASD over-imitated less with familiar objects, alternative explanations (such as the inflexibility typical of ASD; Bauminger-Zviely, 2014) failed to adequately rule out the possibility that children with ASD were over-imitating for social reasons. There is also limited research about what factors may relate to over-imitation. One study found a positive relationship between over-imitation and communication in a sample including children with ASD (Nielsen & Hudry, 2010) General imitation research has demonstrated relationships between both cognitive ability and social motivation and object imitation (Rogers & Williams, 2006; Rogers et al., 2010; Rogers, Hepburn, Stackhouse, & Wehner, 2003); however, this relationship has not been tested in tasks of over-imitation.

Overall, very little research on over-imitation has been conducted with children with ASD to date. The research conducted has not effectively demonstrated whether this behaviour is due to a mistaken causal belief or social reasons. Further, there is little known about what may predict or relate to over-imitation. In contrast, over-imitation with typically developing children (TD children) has been researched more extensively and this literature will help address the gaps in the understanding of over-imitation in children with ASD. More specifically, the TD literature provides a paradigm that will allow for exploration of the social explanation in children with ASD as well as methodology to assess whether the behaviour is due to a mistaken causal belief. Thus, the present study was designed to determine whether the over-imitation behaviour of children with ASD is due to confusion about the causality of the irrelevant actions on the apparatus or whether it is due to motivation to be social with the model. A second goal was to explore possible relationships between over-imitation and cognition,

communication, and social motivation. A group of typically developed peers was used for comparison. It was expected that over-imitation in children with ASD would be the result of confusion about the causality of the irrelevant action and not due to social motivation, and that a positive relationship would be found between over-imitation and proposed correlates.

Over-imitation, at first glance, appears counter-intuitive. Copying behaviours that are irrelevant to the instrumental outcome of an activity could be costly in terms of time and energy (Flynn & Smith, 2012). Imitation, however, plays a vital role in the transmission of cultural information from one generation to the next (Tomasello, 1999) and, as expressed by Flynn and Smith (2012), this cultural information is often opaque. Flynn and Smith (2012) suggest that the copying of irrelevant or unnecessary actions could be adaptive because it "…allows an individual to acquire the idiosyncratic, non-instrumental behaviours that are true of so many cultural rituals" (p. 185). In this way, over-imitation allows individuals to function as cultural units (Flynn & Smith, 2012). Given the wide-reaching implications of over-imitation for the transmission of cultural information, and as an important social learning strategy, it is important to understand why children with ASD over-imitate. Further, the more we know about the mechanism underpinning imitation in children with ASD, the better we will be able to design and implement intervention programs.

Imitation in Children with Autism Spectrum Disorder

In addition to deficits in social-communication and restricted, repetitive behaviours, children with ASD also have deficits in imitation (Rogers & Pennington,

1991; Rogers & Williams, 2006; Smith & Bryson, 2007; Williams et al., 2004). The degree of the imitation deficit appears to vary depending on the type of task in question, such as whether the tasks involves gestural imitation or whether the tasks are object directed imitation.

Research demonstrates that children with ASD perform worse on tasks of gestural imitation than TDC. Sigman and Ungerer (1984) investigated the imitation of familiar gestures (e.g., waving the arm) and novel gestures (e.g., straightening the index finger, patting the top of the head) by school-aged children with ASD. They found children with ASD to be significantly less likely to imitate these gestures in comparison to mental age-matched children. Aldridge, Stone, Sweeney, and Bower (2000) compared preschool-aged children with ASD and TDC on gestural imitation tasks that included tongue protrusion, patting the top of the head with one hand, and wiggling the ears with both hands. No children with ASD performed any of the gestural imitation tasks whereas all TDC imitated at least one gestural task. Beadle-Brown and Whiten (2004) found similar results on body and gestural imitation tasks that included finger wiggle, touch all fingers, extend arms and touch nose, grasp foot, pat top of head, and jump twice. School-aged TDC showed better body and gesture imitation than school-aged children with ASD (Beadle-Brown & Whiten, 2004). Mostofsky et al. (2006) compared the performance of school-aged children with ASD and TDC on gestural imitation that included actions such as waving good-bye and making a fist and found children with ASD to produce fewer imitative gestures than TDC. Freitag, Kleser, and von Gontardf (2006) found reduced imitation of non-meaningful hand and finger gestures in a group of adolescents with ASD compared to controls.

Sequential gestures have also been considered. Single and sequential hand gestures were investigated by Rogers, Bennetto, McEvoy, and Pennington (1996) in adolescents with ASD. Single gestures included extending the arm out with fingers fanned and thumb towards the ceiling and sequential gestures included moving the hand out and horizontally from the shoulder with fingertips and thumb held together and slowly opening as the hand and the arm move and extend. The authors found adolescents with ASD to perform significantly worse than a control group on all sequential hand gestures and on one of the two single hand gestures. Smith and Bryson (1998) also investigated imitation of single hand and finger gestures (e.g., hand postures representing letters from sign language alphabet) as well as sequences of hand and finger gestures (e.g., sequences of fist, palm, and chop gestures) in school-aged children with ASD and TDC. The authors found that, while children with ASD performed more poorly on single gesture imitation tasks compared to TDC, no group differences were found on the sequence gesture imitation task. The non-significant group differences in sequential gestures observed by Smith and Bryson (1998) is contrary to the significant group difference discovered by Rogers et al. (1996). It is difficult to explain the differences between the two studies. In both studies, samples of children with ASD and TDC were matched on chronological age and verbal ability. Furthermore, there does not appear to be an ability difference in terms of autism severity as children with ASD in both studies were described as high-functioning. It is possible that the discrepancy in results may be inherent to the gestural differences of the tasks used in each study, though this would need to be tested.

Research demonstrates that children with ASD are more likely to imitate meaningful versus meaningless gestures. Rogers et al. (1996) investigated the imitation of meaningful hand gestures (e.g., pretend to take a hat off) and non-meaningful hand gestures and found that adolescents with ASD were more likely to imitate the meaningful gestures. Rogers et al. (1996) suggest that meaning aided the performance of the group with ASD. Similar results were found by Vanvuchelen, Roeyers, and De Weerdt (2007) using a battery of meaningful gestures (e.g., salute) and non-meaningful gestures (e.g., hand postures). They found school-aged children with ASD to have more difficulty imitating non-meaningful gestures than meaningful gestures compared to a control group. Williams et al. (2004) suggests that imitation of gesture tasks was aided by adding meaning to the tasks. Overall, research demonstrates that children with ASD perform worse than TDC on tasks of gestural imitation. Within gestural imitation, children with ASD are more likely to imitate gestures that are meaningful.

In contrast to the deficits in gestural imitation, object-directed imitation seems to be relatively spared in children with ASD (DeMeyer et al., 1972; Hammes & Langdell, 1981; Hobson & Lee, 1999; Williams et al., 2004). Royeurs, van Oost, and Bothuyne (1998) found that preschool and school-aged children with ASD imitated significantly more object-directed imitation tasks (e.g., push a button on a toy dog to produce a barking sound) compared to gestural tasks (e.g., bringing tips of fingers together in front of the face, clapping hands). Aldridge et al. (2000) found similar results. In their sample, children with ASD were more likely to imitate object-directed actions, such as pulling apart a toy, compared to gestural imitation. Stone, Ousley, and Littleford (1997) also found gestural imitation (e.g., wave hands, pull on earlobe) to be more difficult for

preschool-aged children with ASD compared to imitation of actions with objects (e.g., walk dog across table, place small block on head).

One exception to the finding that object-directed imitation is spared in children with ASD has been reported. Rogers et al. (2003) found object-directed imitation to be as impaired as overall imitation and oral/facial imitation in a sample of preschool-aged children with ASD. A review of the specific tasks in this study suggested that some of the object-directed actions could be classified as meaningless (e.g., pat a squeaky toy with an elbow, turn a car upside down and pat it). This may explain the impaired performance found by Rogers et al. (2003), as children with ASD tend to perform more poorly on non-meaningful object imitation tasks.

The research comparing object-directed imitation to gestural imitation compared meaningful object-directed imitation to gesture imitation that was mainly non-meaningful. While informative, this research does not speak to the meaningful versus non-meaningful comparison within object-directed tasks. Research demonstrates that children with ASD perform better on object-directed tasks that involve the imitation of meaningful/functional actions than non-meaningful/functional actions. For instance, Stone et al. (1997) had participants observe an experimenter demonstrate both meaningful actions with objects (e.g., shaking a noisemaker, pushing a toy across the table) and non-functional actions with objects (e.g., pushing a teacup across the table, walking hairbrush across table). After each demonstration, children were given an opportunity to manipulate the object. Preschool-aged children with ASD were more likely to imitate meaningful actions compared to non-meaningful actions. These results were replicated by Wu, Chiang, and Hou (2011); they had preschool-aged children with

ASD observe an experimenter demonstrate both meaningful actions with objects (e.g., pushing a toy car across the table) and non-meaningful actions with objects (e.g., push a cup across the table). Children with ASD imitated more meaningful actions than non-meaningful actions (Wu et al., 2011). Rogers et al. (2010) conducted a similar study comparing the imitation of functional and non-functional actions with objects in preschool-aged children with ASD. Children with ASD observed either the functional or non-functional actions. Functional actions included shaking a maraca, scribbling with a marker, blowing cotton, shaking bells, drawing a line with a marker held in the mouth, poking putty, tearing a lollipop wrapper, and licking a lollipop. Non-functional actions included shaking a potato masher, scribbling with a straw, blowing a stone, shaking a cloth, drawing a line with a stick held in the mouth, poking a sponge, tearing a piece of paper, and licking a plastic disk. Rogers et al. (2010) found that children with ASD were more likely to imitate the functional or meaningful actions compared to the non-functional actions.

This review of the literature on imitation in children with ASD demonstrates that these children are more likely to imitate object-directed actions than gestures and are more likely to imitate meaningful/functional actions compared to non-meaningful actions. Another way to consider these findings is in light of the functions of the behaviours. When children imitate meaningful or functional actions, it is thought that they do so because these actions serve a cognitive-apprenticeship function. Children are imitating to learn about goal-directed actions (Rogers et al., 2003; Uzgiris, 1981). When children imitate non-functional or non-meaningful actions or gestures, it is thought that they do so because these actions serve a social-communicative function (Rogers et al.,

2003; Uzgiris, 1981). That is, with the social-communicative function, children imitate to communicate mutuality, to share understanding, and because of a desire to connect with another person (Over & Carpenter, 2012a; Uzgiris, 1981). This suggests that children with ASD are more likely to imitate when the actions serve a cognitive function, rather than a social function.

Over-imitation in children with Autism Spectrum Disorder

Over-imitation is another area of imitation that has been explored with children with ASD. It has been suggested that TD children over-imitate because they want to affiliate with, be like, and engage socially with the model (Nielsen, 2006; Nielsen & Blank, 2011; Over & Carpenter, 2012a; Uzgiris, 1981). Originally, studies of over-imitation with children with ASD were aimed at testing this viewpoint. That is, if the social explanation indeed explained over-imitation, it was hypothesized that children with ASD would *not* over-imitate due to their deficits in social interaction and communication (Nielsen & Hudry, 2010; Nielsen et al., 2013). Further, as outlined above, general imitation research has repeatedly found that children with ASD are less likely to imitate actions that serve a social function, strengthening the hypothesis that children with ASD would not demonstrate over-imitation. However, contrary to expectations, results revealed children with ASD did over-imitate (Nielsen & Hurdy, 2010; Nielsen et al., 2013).

The initial studies of over-imitation with children with ASD were done by Nielsen and colleagues (Nielsen & Hudry, 2010; Nielsen et al., 2013). Nielsen and Hudry (2010) explored over-imitation in school-age children with ASD and children

with Down Syndrome by presenting them with apparatuses that could be opened to retrieve a toy. Each apparatus could be efficiently opened by using one's hand to operate a switch on the front of the apparatus, which would result in the lid opening. Instead of demonstrating the efficient method (i.e., opening by hand), participants witnessed a model use a tool to activate the switch on the apparatus, which opened the lid. The authors proposed that copying the irrelevant action of using the tool would suggest over-imitation, whereas using a more efficient method, such as one's hands, would argue against over-imitation. Results showed that all children showed a high rate of opening the apparatuses using the tool and that no differences were found between children with ASD and children with Down Syndrome (Nielsen & Hudry, 2010).

While this study demonstrated that children with ASD faithfully imitated the actions made on an apparatus by a model, it may have been unclear to the participants whether the action made on the apparatus with the tool was actually unnecessary (Nielsen et al., 2013). Thus, participants may have over-imitated because they had a mistaken belief that the action was causally necessary. For over-imitation to be accurately assessed, the irrelevant actions must be obviously not causally necessary to completing the task. Nielsen et al. (2013) attempted to overcome this criticism by making the irrelevant action with the tool on an area of the apparatus located away from the opening mechanism. The irrelevant action was followed by a causally related action with the tool that allowed the apparatus to be opened. Thus, there were two separate actions – the *irrelevant action* made with the tool, and the *causally related* action with the tool that allowed the box to be opened. Similar to previous research, school age children with ASD imitated causally *irrelevant actions* to the same extent as TD

children (Nielsen et al., 2013). Furthermore, the causally related action could have been completed using one's hand in place of the tool, rendering the use of the tool for this action as unnecessary. Children with ASD and TD children produced the causally *related* actions with the tool at the same high levels (Nielsen et al., 2013).

By making the irrelevant action on a part of the apparatus unrelated to the opening, the results of Nielsen et al. (2013) appear to rule out a mistaken causal belief. However, the apparatuses used in Nielsen and Hudry (2010) and Nielsen et al. (2013) were opaque. Whether a mistaken causal belief is the reason for over-imitation may be particularly difficult to determine with opaque apparatuses because the opacity prevents participants from seeing that there are no hidden mechanisms activated by the irrelevant action. Thus, though Nielsen et al. (2013) attempted to make it obvious that the irrelevant action was not causally related to the goal of opening the box, the opacity of the apparatus may have precluded participants from making this determination. Therefore, it might be that children included the irrelevant action because they still thought it was causally necessary.

The work of Nielsen and colleagues was aimed at demonstrating that children with ASD would not imitate actions that were obviously not causally necessary. In contrast, Marsh et al. (2013) more explicitly attempted to elicit the social aspects of over-imitation. Marsh et al. (2013) proposed that typical over-imitation paradigms did not assess over-imitation but instead assessed object learning because the apparatuses were novel. Imitation on novel objects would fall within the cognitive-apprenticeship function of imitation because children are learning about goal-directed actions (Rogers et al., 2003; Uzgiris, 1981); hence, children with ASD would be expected to imitate

under these conditions (Rogers et al., 2010). To compensate for this, Marsh et al. (2013) tested whether school age children with and without ASD would imitate irrelevant actions when the actions were demonstrated on familiar objects. Familiar objects purportedly removed the object-learning component and, thus, imitation of irrelevant actions would serve a social function.

When children were tested with familiar objects, children with ASD were significantly less likely to include the unnecessary actions than TD children. Marsh et al. (2013) suggest that failure to include the unnecessary actions could be explained in terms of reduced social motivation to affiliate with the model. This explanation fits with our understanding of ASD; however, children with ASD often display excessive adherence to routine and rules, and rigidity in thinking (Bauminger-Zviely, 2014). This might cause them to perseverate on a previously learned way of interacting with familiar objects. Thus, it is possible that children with ASD did not include the irrelevant action because of less desire for social affiliation or because they already had a norm for the familiar objects which they were unable to inhibit to learn a new one. Therefore, the use of familiar objects by Marsh et al. (2013) does not adequately rule out a social affiliation explanation for over-imitation behaviour by participants with ASD.

To summarize, the findings from over-imitation research with children with ASD are interesting, surprising, and paradoxical. Previous research has shown children with ASD to imitate functional or meaningful actions more readily than meaningless and non-functional actions (Rogers et al., 2010). Over-imitation seems contrary to this finding in the sense that children are imitating actions that have no functional relationship to the goal and are using a tool rather than their hands when a more efficient

method is available. Some researchers have suggested that children with ASD may have a mistaken belief that the irrelevant action and/or the tool is somehow causally necessary for opening the apparatus. Initial attempts at demonstrating that children with ASD have a mistaken causal belief were unsuccessful as the use of opaque apparatuses does not allow for adequate testing of this hypothesis (Nielsen & Blank, 2010; Nielsen et al., 2013). In contrast, initial attempts at demonstrating that over-imitation in children with ASD was not for social reasons was suggestive but the lack of over-imitation on familiar objects by children with ASD is open to alternative explanations. Thus, the possibility that children with ASD included the irrelevant actions, or used the tool when their hands would be more efficient, due to a mistaken belief about causality, and not for social reasons, has not been firmly established. These issues have been explored more fully with TD children; therefore, exploring the TD literature may provide direction for understanding over-imitation children with ASD.

Over-imitation in Typically Developing Participants

Over-imitation in TD children has generally followed three lines of investigation: ruling out distorted causal beliefs, determining whether children over-imitate for social reasons, and demonstrating that children learn norms for interacting with objects, which causes them to over-imitate. The idea that over-imitation is due to a mistaken causal belief attributes over-imitation to a tendency to encode irrelevant (but obviously intentional) actions as causally necessary for achieving the final state. A variant of the mistaken causal beliefs theory suggests that children interpret the unnecessary action as having been intentionally performed for some goal-directed reason although they are unsure of what the purpose or reason actually is (Kenward et

al., 2011). Others suggest that the copying of irrelevant actions is based on a desire to share the experience with the model, to be affiliated with the model, or to be liked by the person modelling the actions (Nielsen, 2006; Nielsen & Blank, 2011; Over & Carpenter, 2012a; Uzgiris, 1981). Thus, the inclusion of obviously irrelevant actions is done for purely social reasons and to engage with the model (Over & Carpenter, 2012a). Another perspective is that children include the irrelevant action because they have learned a norm that the action should be included when manipulating the apparatus (Kenward et al., 2011; Kenward 2012).

Behaviour with opaque apparatuses can be compared with transparent apparatuses to better understand the mistaken causal belief perspective. Transparent apparatuses allow the causal significance of all actions to be clearly visible. Thus, participants can see that the unnecessary action has no causal relationship to the retrieval of the object housed in the apparatus. The same is not the case with opaque apparatuses, even if the irrelevant action is made on a part of the apparatus that is not located near the opening mechanism. Research with TD children that has compared opaque and transparent apparatuses found them to imitate the irrelevant actions regardless of the type of apparatus used (Horner & Whiten, 2005; McGuigan, Whiten, Flynn, & Horner, 2007).

While it would appear that over-imitation with transparent apparatuses argues against the behaviour being due to a distorted causal belief about the irrelevant action, others have argued against this. Proponents of the distorted causal beliefs explanation for over-imitation suggest that children may treat the adults as knowledgeable and reliable sources of information about the apparatus, and that this may influence their

causal beliefs (Lyons et al., 2011). McGuigan et al. (2007) investigated over-imitation using transparent apparatuses and both child and adult models. Participants included TD children and adults. All participants were more likely to imitate the irrelevant action when the model was an adult than when the model was a child (McGuigan et al., 2007). This finding suggests that perceived expertise of the model may play a role in over-imitation of irrelevant actions. However, others have found TD adults over-imitate the actions of a model with no task knowledge (Flynn & Smith, 2012), questioning the role of model expertise in the formation of distorted causal beliefs.

In a series of studies using transparent apparatuses, Lyons et al. (2007) had TD children partake in training phases where they identified which actions were necessary in retrieving an object, and which were "silly" and unnecessary. Participants received corrective feedback and praise when they correctly identified irrelevant actions. Lyons et al. (2007) also directly instructed participants to copy only the necessary actions when retrieving the object prior to an experimental phase. Results revealed persistent imitation of causally irrelevant actions. Lyons et al. (2007) propose that the encoding of purposeful actions is so automatic that it causes misencoding of irrelevant actions as causally necessary, which leads to distortions in children's causal beliefs about the apparatus. The misencoding results in imitation of the causally irrelevant actions; children think the actions are causally necessary. In their experiments, the child was alone with the apparatus, yet the child still copied the irrelevant actions (Lyons et al., 2007). Lyons et al. (2007) used this finding to argue against a social explanation for the behaviour noting it unlikely that the child would over-imitate to be social with the model when there was no model in the room. However, even though the model was not present

in the Lyons et al. (2007) study, it is possible that participants continued to over-imitate because of a desire to affiliate with and be like the model who left the room.

Kenward et al. (2011) sought to further investigate the distorted causal beliefs hypothesis against alternative explanations by asking children to justify their behaviour verbally. They had children observe a model demonstrate an irrelevant action, followed by a necessary action, on either a simple or a complex transparent apparatus to retrieve an object. Before children were given an opportunity to manipulate the apparatus, their parents asked them a series of questions about how they were going to retrieve the object and why they would perform the actions. After answering the questions, children were given the apparatus to manipulate and the examiner left the room. Analyses only included participants who displayed the unnecessary action when retrieving the object. The majority of participants in both the simple and complex apparatus groups stated that the related action was necessary to retrieve the object. The majority of children in the simple apparatus group stated that they were unsure why the unnecessary action should be performed, that they would not perform the unnecessary action (though all did), or that it did not retrieve the object. More children in the complex apparatus group, compared to the simple apparatus group, stated that the unnecessary action caused retrieval of the object. Kenward and colleagues (2011) argue that these results could be consistent with a weak version of the distorted causal beliefs hypothesis. In particular, they argue that participants may have thought the unnecessary action had some goal-directed purpose and so they performed it, even though they were unsure what the purpose was. Alternatively, they suggest that participants may have included the

unnecessary actions on both apparatuses because they learned a norm that the unnecessary action should be performed in the series of actions.

In contrast to the above studies which have largely explored causal explanations for over-imitation, Nielsen and Blank (2011) conducted a study with preschool age TD children directly assessing the social explanation for over-imitation. Participants observed two models demonstrate how to use a tool to operate the same opaque apparatus in order to retrieve a toy. One model (efficient model) opened the apparatus using only causally related actions. The other model (irrelevant model) first modelled irrelevant actions, followed by the same causally related actions as the first model, to retrieve the toy. One model then left the room and the child was given the apparatus to manipulate with the remaining model. For some children, the efficient model remained in the room and for others the irrelevant model remained. Results indicated that participants were significantly more likely to copy the irrelevant actions when the irrelevant model remained in the room compared to when the efficient model remained. In both of these conditions, participants observed that the unnecessary action was actually unnecessary to retrieve the toy from the apparatus. However, only when the model who displayed the unnecessary actions remained in the room did more participants produce the causally unnecessary actions themselves. These results strongly argue against the behaviour being the result of a mistaken causal belief. Even though the apparatuses used were opaque, all participants observed an efficient model and saw that the irrelevant action was not causally necessary. Nielsen and Blank (2011) suggest that the results support the social affiliation theory of over-imitation: imitating the

unnecessary actions was motivated by a desire to engage socially and share the experience with the model (Nielsen & Blank, 2011).

Finally, Kenward (2012) and Keupp et al. (2013) tested the normativity explanation by manipulating whether a puppet included or omitted the irrelevant action on the apparatus. After the model demonstrated the actions, both the child and puppet had a turn manipulating the apparatus. On occasion, the puppet would omit the irrelevant action. Results revealed high rates of over-imitation by the children, and protest when the puppet *omitted* the irrelevant action. Researchers have proposed that the protest made by children when the puppet omitted the irrelevant action was because the puppet violated the normative behaviour of including the irrelevant action. That is, the children saw the irrelevant action as an essential, normative component of the larger conventional action sequence (Keupp et al., 2013).

In conclusion, there is some evidence suggesting TD children might over-imitate due to a distorted belief that the irrelevant action is causally necessary. However, this evidence is not unequivocal with some findings being open to alternative explanations. In addition, it is difficult to see how distorted causal beliefs could explain why children would produce irrelevant actions in the presence of one model and not another (Nielsen & Blank, 2011), or why they would protest the puppets leaving out an irrelevant action (Kenward, 2012; Keupp et al., 2013) once the children have seen through demonstration that the irrelevant action is not causally necessary to achieve the goal. While the children could have learned a norm that the action should have been performed, it is unclear why children would perform the irrelevant actions when one model was present and not the other, unless seeing the objects manipulated in two

different ways (i.e., with and without the irrelevant actions) taught the children that there is no norm for interacting with those objects. If that were true, one would expect random performance. However, children did not perform randomly; instead they produced the irrelevant actions when the model who had produced irrelevant actions was present, and omitted the irrelevant actions when the model who had not produced them was present (Nielsen & Blank, 2011). Overall, these results suggest that TD children over-imitate for social reasons, to affiliate with, or be like, the model.

These results have implications for the understanding of over-imitation in children with ASD. If children with ASD over-imitate due to a distorted causal belief or because they believe the irrelevant action is necessary for some unspecified goal-directed reason, then they should not over-imitate when given evidence that the irrelevant action is unnecessary. For example, in the paradigm used by Nielsen and Blank (2011) with two models, where participants always observed one model using an efficient method for opening the apparatus (i.e., without the irrelevant action), children with ASD should omit the irrelevant action regardless of which model remains in the room because they see that the action is not causally necessary. Lack of over-imitation under these conditions would argue against children with ASD over-imitating for social reasons. However, it would not provide objective evidence that they are over-imitating because they have a mistaken causal belief. To do that, it is necessary to demonstrate that children with ASD over-imitate in situations where the causal mechanism is obscured and do not over-imitate when the causal mechanism is clearly visible. The simplest way to do this would be to compare their responses to opaque versus transparent apparatuses. If children with ASD hold a mistaken causal belief, they should

include the irrelevant action with the opaque apparatus but not the transparent apparatus because they would see that the action is not functionally necessary. Further, they should use their hands more than the tool once they see that it is also not functionally necessary.

Factors that may relate to over-imitation

Age

Stone and colleagues (1997) found that the ability of preschool-aged children with ASD to imitate improved from the ages of 24 months to 36 months. Research with school-age and adolescent children with ASD has found no age differences in object-directed and gestural imitation across that age range (Charman & Baron-Cohen, 1994; Hobson & Lee, 1999; Roeyers et al. 1998). Research comparing children and adults with ASD has found that young children with ASD tend to have significantly lower imitation scores than older children and adults with ASD (Whiten & Brown, 1998), and that older children and adults with ASD tend to perform comparably to each other and to TDC (Beadle-Brown & Whiten, 2004; Whiten & Brown, 1998). These results suggest that imitation is present in preschool-aged children with ASD and increases as the age of the sample increases to adulthood.

Over-imitation research with children with ASD has found the behaviour to be present in children ranging in age from 32 months to 8 years using (Nielsen & Hudry, 2010; Nielsen et al., 2013). Nielsen and Hudry (2010) split their sample into children younger and older than 5.5 years of age and found no differences in over-imitation behaviour based on chronological age. With the TD population, over-imitation has been

found in children from ages two to 13 years (Horner & Whiten, 2005; Lyons et al., 2007, 2011; Nielsen & Tomaselli, 2010; McGuigan et al., 2007; Nielsen et al., 2014), as well as with adults (Flynn & Smith, 2012; McGuigan et al., 2011). McGuigan et al. (2011) found over-imitation to increase in children from age 3 years to age 5 years and found 5-year old children to over-imitate at similar rates as adults. One study of TD children compared 2- to 5-year old children with a 6- to 13-year old group and the older children produced more irrelevant actions than the younger children (Nielsen & Tomaselli, 2010). Age has not been documented in as broad an age range with children with ASD as with TD children. Given that children with ASD have been found to over-imitate to the same extent as TD peers, it seems likely that older children and adolescents with ASD will continue to show the behaviour alongside same-age TD peers. It is less clear, however, whether age will be related to over-imitation given what has been reported about over-imitation with different age groups. The current study will consider whether age is related to the imitation of irrelevant actions. If this is the case, age will be controlled for in analyses.

Communication

Toth, Munson, Meltzoff, and Dawson (2006) suggest that imitation is a skill that may "set the stage" for social and communicative exchanges in which language can develop. Thus, the presence of imitation skills should relate positively to communication skills. One study found a positive relationship between the imitation of causally irrelevant actions and communication (Nielsen & Hudry, 2010). Toth and colleagues (2006) reported significant positive correlations between object-directed imitation and receptive and expressive language. Similar results were also found by Stone et al (1997)

who found a positive relationship between gestural imitation and expressive language in preschool-aged children with ASD.

Not all research has found a relationship between communication and imitation. Rogers and colleagues (2003) found no relationship between expressive language and either object-directed or gestural imitation in preschool-aged children with ASD. The authors suggest that their results differed from Stone and colleagues (1997) because they partialled out developmental levels in their analysis. Freitag and colleagues (2006) investigated the relationship between imitation of non-meaningful hand and finger gestures, and language measures that assessed pragmatic aspects of language, spontaneous speech, communicative behaviour, articulation and prosody, and written language in a sample of adolescents with ASD and a control group. No relationship was found between the language measures and imitation; however, the authors speculated that this may have been due to low sample size (Freitag et al., 2006). Overall, results considering the relationship between imitation and language appear mixed with one study finding a positive relationship between communication and over-imitation. Given the possible link between imitation and language, further research exploring this relationship is necessary.

Cognitive ability

Cognitive ability has yet to be investigated specifically in regards to over-imitation; however, cognitive ability is often significantly correlated with general imitative ability in children with ASD (Rogers & Williams, 2006). Positive relationships have been found between imitation and mental age (Roeyers et al., 1998) and verbal and

nonverbal developmental quotients (Rogers et al., 2003) for preschool and school-aged children with ASD, and between imitation and overall intellectual functioning for preschool-aged children with ASD and TDC (Rogers, Young, Cook, Giolzetti, & Ozonoff, 2008). Vanvuchelen and colleagues (2007) found reduced imitation of meaningful gestures for school-aged children with ASD who were intellectually disabled but not for higher functioning school-aged children with ASD. Non-functional object-directed tasks are less likely to be imitated by children with ASD compared to functional object tasks and Rogers et al. (2010) found this to be particularly evident for children with lower verbal mental ages (i.e., 14 months of age) compared to children with higher verbal mental ages (i.e. 29 months of age). In contrast, Charman and Baron-Cohen (1994) found no relationship between object-directed imitation and mental age in their school-aged sample with ASD. It is unclear why these latter results are different as similar tasks were used in all studies. Overall, the majority of research suggests a positive relationship between cognitive ability/mental age and imitation.

Social motivation

Social factors associated with over-imitation in children with ASD have yet to be investigated. In regards to general imitation, impaired social responsivity has been found to relate to fewer imitation skills in children with ASD (Rogers et al., 2003). Furthermore, children with ASD are less likely to imitate tasks that serve the social function of imitation (e.g., imitation of non-meaningful and non-functional gestures and actions) compared to the tasks that serve the cognitive apprenticeship function of imitation (e.g., Stone et al., 1997; Williams et al., 2004). Another form of imitation that is believed to serve the social function is imitating the style or technique by which the

object-directed action is executed (Hobson & Lee, 1999). Imitating the style of actions was investigated by Hobson and Lee (1999). For example, participants observed a model move a wooden stick against a pipe-rack in either a harsh style (abrupt strumming of the stick) or a gentle style (strumming the stick in a gentle, graceful way). Nearly all participants imitated the goal-directed action but not the style of the action. Whiten and Brown (1998) also investigated whether school-aged children and adults with ASD and preschool and school-aged TD children would copy the specific technique used by a model to retrieve a reward held inside an object. For example, the model either demonstrated a twist technique to manipulate the object and access the reward or a poke technique. TD children, but not children with ASD imitated the technique used by the model. These findings suggest that children with ASD do not imitate the specific style or technique modeled by the examiner, which are the aspects of tasks that are assumed to have a more social purpose (Hobson & Lee, 1999; Whiten & Brown, 1998). However, other research suggests that when children with ASD do imitate, the amount of object imitation is related to social responsivity (Rogers et al., 2003). The results concerning the relationship between social factors and imitation in children with ASD are mixed. Given that over-imitation by TD children may be based on motivation to be social and affiliate with the model (Nielsen & Blank, 2011), children's motivation to initiate social interaction was considered here.

To summarize, there is limited research on what factors may relate to over-imitation. One study has found a positive relationship between over-imitation and communication in a sample with ASD. Research has not directly investigated the

relationships between over-imitation and cognitive ability or over-imitation and social factors.

The Current Study

There were two goals to this study. This first goal was to a) demonstrate that children with ASD over-imitate because they believe the irrelevant actions are causally necessary to the goal of the task and b) to demonstrate that they are not over-imitating because of a desire for social affiliation with the model. A sample of TD children was included in the research design to provide a comparison to the behaviour of children with ASD. Previous research found no differences in the imitation of irrelevant actions between the two groups (Nielsen et al., 2013). However, it was expected that differences in responses would emerge based on the experimental manipulations used here. Over-imitation was considered in children with ASD and TD children between ages 6 to16 years. Over-imitation has been demonstrated in TD developing children in this age range and children with ASD between the ages of 2 to 8 years of age. Given that children with ASD have been found to over-imitate to the same extent as TD children, it was expected that children with ASD up to the age of 16 would also over-imitate.

The second goal was to examine potential correlates of over-imitation including cognitive ability, communication, and social motivation. The majority of general imitation research has found a positive relationship between cognitive ability and imitation skills in ASD (Rogers & Williams, 2006). To determine if the same relationship exists for over-imitation and children with ASD, cognitive ability was assessed using a standardized measure that was individually administered by the

examiner. Nielsen and Hudry (2010) reported a positive relationship between communication skills and over-imitation in children with ASD. To determine whether this result was replicable, information about communication was obtained via parent report of their child's communicative ability using a standardized questionnaire. The final variable of interest was social motivation. To determine whether a relationship exists between social motivation and over-imitation, information about social motivation was gathered via parent report of their child's social motivation using a standardized questionnaire.

The over-imitation tasks for this project involved motor skills. There is no evidence that motor functioning explains variance in imitation above overall developmental functioning (Rogers et al., 1996). Regardless, to attribute performance on over-imitation tasks to theoretical explanations, rather than inadequate motor skills, information about motor functioning was gathered. The over-imitation tasks for this study also involved an element of working memory in that children had to remember the irrelevant and relevant actions repeated across three demonstrations. Though research has not found differences in memory for immediate single or sequential movement hand tasks between children with ASD and TD children (Rogers et al., 1996), some evidence suggests differences in spatial working memory between these groups (Ozonoff and Strayer, 2001; Williams et al., 2005). To attribute performance on over-imitation tasks to theoretical explanations and not working memory, participants took part in two brief memory tasks.

To address the goals of this study, an experimental procedure using apparatuses specially designed for this project was employed. Apparatuses were either opaque or

transparent, all contained an object, and all were accompanied by a tool. A three-phase experimental design was used (see Table 1). Each phase used two apparatuses with three demonstrations per apparatus. In Phase I, participants observed a model display causally irrelevant actions with a tool, followed by causally relevant actions with the same tool, on an opaque apparatus to retrieve the reward (i.e., the object inside). Phase II was similar to Nielsen and Blank (2011) and used two models. One model displayed the causally irrelevant and relevant actions and the other model displayed only the relevant actions on the same opaque apparatus. Following the demonstrations, participants were randomly assigned to one of two conditions. In one condition, the irrelevant model left the room (efficient-model stays condition) and in the second condition the efficient model left the room (irrelevant-model stays condition). In both conditions, participants were given an obvious reason to omit the irrelevant actions: the efficient model demonstrated that the irrelevant actions were not causally necessary. Phase III was similar to Phase I except the apparatuses were transparent. The same model from Phase I displayed the causally irrelevant actions with a tool, followed by the causally related action with the tool, on a transparent apparatus to retrieve the reward.

In all phases, with each apparatus, the same general procedure of presenting the apparatus, modelling the actions three times, then giving participants the opportunity to manipulate the apparatus, was used. The causally irrelevant actions in Phases I and II were performed on a part of the apparatus that was not near the opening and in such a way that was obviously not related to opening the apparatus (see Table 2 for details about apparatuses and associated actions). Similar actions with the tool were made on

the apparatuses in Phase III; however, the irrelevance of the unnecessary actions in this phase was obvious because the apparatuses were clear.

Research Questions and Hypotheses

Research question one. The first research question considered why children with ASD over-imitate. Previous research has found children with ASD to over-imitate with novel, opaque apparatuses. It is possible they included the *irrelevant* action because they believed it to be causally related to the goal and the opacity of the apparatuses may have contributed to this. The same reasoning may also apply to the use of the tool for the causally *related* action – it is possible children thought it necessary to use the tool with opaque apparatuses and not their hands. It seems less likely that children with ASD over-imitated because of social motivation. If children with ASD are shown that the irrelevant action is not causally necessary, such as through transparent apparatuses or the demonstration by an efficient model, it is possible they will no longer include the irrelevant action and it is possible they will no longer use the tool.

Hypothesis 1A. Children with ASD over-imitate because they believe the irrelevant actions are causally related to the goal and not because they have a desire to affiliate with the model. Children with ASD will include the irrelevant action more often with the opaque apparatuses than with the transparent apparatuses. They will include the irrelevant actions in both Phase II conditions less often than TD children. TD children will imitate the irrelevant action with both the opaque apparatuses and transparent apparatuses and they will be more likely to include the irrelevant action in the Phase II condition where the efficient model stays.

Hypothesis 1B. Children with ASD use the tool for the related action because they think it is causally necessary to do so. In conditions where the irrelevant action is more obviously causally irrelevant (e.g., Phase III and both Phase II conditions), children with ASD may use their hands to produce the causally related action more frequently than TD children. If it is clearly evident that the causally irrelevant action is not necessary, such as in these conditions, participants may assume that the use of the tool is also not necessary for the causally related action.

Research question two. This research question considered whether cognitive ability, communication, and social motivation are associated with individual differences in over-imitation.

Hypothesis 2A. A positive relationship will be found between cognitive ability, communication, and social motivation, and the imitation of causally irrelevant actions for all participants in Phase I. This analysis will be conducted using Phase I data because it represents a standard over-imitation task used in the literature.

Hypothesis 2B. A positive relationship will be found between cognitive ability, communication, and social motivation and the imitation of causally irrelevant actions by all participants in the Phase II irrelevant-model stays condition. Data from the Phase II irrelevant-model stays condition will be used because it more specifically explores the social explanation of over-imitation.

No specific predictions were made about which variable will explain more variance in either the Phase I or Phase II irrelevant-model stays analyses for Hypothesis 2A or 2B, respectively.

Chapter 2

Method

Participants

Participants comprised 26 children with a community diagnosis of ASD (20 males) and 26 TDC (19 males); children were matched on nonverbal abilities and age. Participants were between the ages of six and 16 years. Participants with and without ASD were recruited through the Infant and Child Studies database, posters, social media networks, and electronic notice boards (Appendices A-D). Participants with ASD were also recruited through a local autism support agency and the private practices of local psychologists (Appendices E-F). Parents completed a demographic information form (Appendix G).

Participants were compared on demographic information and descriptive information. Categorical variables (i.e., sex and demographic variables) were examined using chi-square tests of independence, with $p < .05$ as the significance level. Continuous variables (i.e., age, perceptual reasoning, cognitive functioning, communication, and social motivation) were examined with t-tests, with $p < .05$ as the significance level. There was a significant difference in income level between the two groups (see Table 3); more parents of TD children reported higher income levels (e.g., $110-119,000 and +$120,000 income ranges) than parents of children with ASD and mothers of TD children reported marginally higher education levels than mothers of children with ASD. TD children had significantly higher scores on communication than

children with ASD. There were also significantly lower levels of social motivation for children with ASD (see Table 4).

Standardized measures

Social Responsiveness Scale Second Edition (SRS-2; Constantino & Gruber, 2012). The SRS-2 is a parent-report tool that measures the severity of social impairment in children with ASD ages four to 18 years. The SRS-2 provides a total score for the severity of social deficits and also provides separate scores for each of five subscales: social awareness, social cognition, social communication, social motivation, and restricted interests and repetitive behaviour. The social motivation scale looks at the extent to which the individual is motivated to engage in social-interpersonal behaviour (Constantino & Gruber, 2012). This score was used in the analysis to determine whether level of social motivation relates to the presence of over-imitation behaviour. The SRS-2 total score provided ASD diagnostic information in the form of a cut-off score. The total score was used to verify community diagnoses of ASD in children with ASD and to confirm the absence of ASD in TD children.

The manual reports an internal consistency coefficient alpha of .95 and retest reliability ranging from r = .88-.95 (Constantino & Gruber, 2012). The manual also reports convergent validity with the Autism Diagnostic Interview-Revised ranging from r = .65-.77 for mother reports, and r = .60-.74 for father reports, and with the Autism Diagnostic Observation Schedule ranging from r = .27-.58. There are 65 items in total and parents responded to each on a four-point scale.

Vineland Adaptive Behaviour Scales Second Edition – Parent/Caregiver Rating Form (VABS-II; Sparrow, Cicchetti, & Bella, 2005). The VABS-II is a measure of adaptive behaviour from birth to adulthood that provides information about an individual's functioning in the areas of communication, daily living skills, socialization, and motor skills. Parents completed the parent/caregiver rating form. The communication and motor scores were used here. The communication score is a composite of receptive language, expressive language, and written language. The manual reported internal consistency split half reliability for the communication domain ranging from r = .87-.94, and test retest reliability intra-class correlations (ICC) ranging from ICC = .76 - .90. The manual reported concurrent validity between the VABS-II communication and the Adaptive Behaviour Assessment System, Second Edition communication areas ranging from .59-.73 (Sparrow et al., 2005).

The VABS-II motor score provided information about fine motor functioning typically expected in children up to age six years. The minimal developmental level of motor activity required for the over-imitation tasks was estimated to be approximately five years. Parents of participants who were six years of age completed the motor section. Parents of participants aged seven years and older were queried about their child's fine motor functioning (e.g., writing, drawing pictures, typing, putting things together). Parents of children age seven years and older who reported problems with fine motor functioning completed the fine motor skills section of the VABS-II. If parent responses on the motor section of the VABS-II indicated that their child did not have the fine motor skills typical of a five-year old, that participant would be excluded from analysis. If parent responses on the VABS-II indicated that the child did have the fine

motor skills typical of a five-year old, he or she was included in analysis. All parents who completed the motor section of the VABS indicated that their child had fine motor skills typical of a five-year old. No participants were excluded from analysis because of fine motor skill concerns. All participants had fine motor skills sufficient to carry out the over-imitation tasks.

Childhood Autism Rating Scale – Second Edition (CARS-II; Schopler, Van Bourgondien, Wellman, & Love, 2010). The CARS-II is an examiner-administered rating scale that is used to identify ASD in children. Examiners rate the child on 15 items across a number of functional areas based on behavioural observations made throughout the session, and scores are totalled to yield an overall score. Individuals who score at/above a certain point are classified as having autism. There are two possible forms to use. The Standard form is for use with individuals younger than six years of age, who have communication difficulties, or who have below-average estimated IQ's. The High-Functioning form is used for assessing verbally fluent individuals, six years of age and older, and for those with IQ scores above 80. Internal consistency reliability coefficient for the Standard Form is r = .93 and for the High-Functioning form is r = .96 (Vaughan, 2011). Interrater reliability for the High-Functioning form is r = .95; interrater reliability for the Standard Form was not provided (Vaughan, 2011). Sensitivity and specificity values for the Standard Form were .88 and .86, respectively, and for the High-Functioning they form were .81 and .87, respectively (Vaughan, 2011). Finally, concurrent validity with the Autism Diagnostic Observation Schedule and the Standard Form was r = .79 and the High-Functioning form was r = .77 (Vaughan, 2011). Choice of form was based on the results of the measure of cognitive ability (see below),

observed verbal fluency, and the age of participants. All participants were rated using the High Functioning form after the session had ended. All participants with a community diagnosis of ASD scored in the Autism Spectrum Disorder range on the CARS-II. These scores were used to confirm the community diagnosis of ASD in children with ASD and to confirm the absence of ASD in TD children.

Wechsler Abbreviated Scale of Intelligence – Second Edition (WASI-II; Wechsler, 2011). The WASI-II provides an estimate of general intellectual cognitive ability in individuals ages six to adulthood. It consists of four subtests (Vocabulary, Similarities, Block Design, and Matrix Reasoning) and provides a verbal comprehension index score (VCI), perceptual reasoning index score (PRI), and a full-scale IQ score (FSIQ). The manual reports internal consistency split-half reliability for the VCI ranging from r = .92-.96, for the PRI ranging from r = .90-.92, and for the FSIQ ranging from r = .95-.97 and Pearson's product-moment correlation test retest reliability for the VCI ranging from r = .93-.96, for the PRI ranging from r = .86-.93, and for the FSIQ ranging from r = .92-.96. The manual reports concurrent validity for the VCI, PRI, and FSIQ between the WASI-II and the Wechsler Scale of Intelligence for Children-Fourth Edition (r =.79-.88) and between the WASI-II and the Wechsler Adult Intelligence Scale-Fourth Edition (r = .83-.90). Participants were administered the test by the examiner; the test took approximately 30 minutes. Scoring of the WASI-II was completed after the session had ended. Participants with a PRI score of 80 or above were included in analyses. One child with ASD scored below 80 and was not included in analyses. Participants with ASD and TD children were matched group-wise on the PRI.

Overall, the group of children with ASD and the group of TD children were not statistically different on PRI scores $t(50) = -1.29$, $p = .08$ (see Table 4).

Autism Spectrum Disorder Diagnostic Information

Community diagnosis. The group of children with ASD all had a community diagnosis of ASD. Clinical diagnoses of ASD in the province of New Brunswick are made by psychologists, psychiatrists, and pediatricians.

Standardized measures. Two measures were used to verify the community diagnosis. The SRS-2 and CARS-II (described above) both provided ASD diagnostic information in the form of a cut-off score. A score above the ASD cut-off on the SRS-2 total score and CARS-II were required for all participants in the ASD group to support the community diagnosis. One child with a community diagnosis of ASD did not score above the ASD cut-off score on the SRS-2 and was excluded from analysis. All TD children scored below the ASD cut-off scores and parents reported no developmental delays or difficulties.

Materials for experimental tasks

Memory tasks. All participants took part in a verbal and a nonverbal memory task administered by the examiner. On the verbal task, the examiner said out loud a string of numbers beginning with two numbers and increasing up to six possible numbers. Two sets of numbers for each length were used. The examiner said the numbers out loud and asked the participant to repeat them back in the same order. The task ended when the participant failed to successfully repeat both sets of numbers in one length category. On the nonverbal task, each child was shown two cards with four

pictures on each (Appendix H). One card was presented at a time. On the first card, the examiner pointed to a sequence of two pictures in a pre-determined order and offered the card to participants to do the same; on this same card, the examiner then pointed to two pictures in a different sequence and offered the card to the participant. On the second card, the same procedure was used except the examiner pointed to a sequence of three pictures during each demonstration. These tasks were used to determine whether participants had the working memory capacity to remember the short sequence of actions presented in the over-imitation tasks. All participants responded sufficiently on both the verbal and nonverbal tasks to rule out concerns with working memory capacity as a determinant of behaviour on the over-imitation tasks.

Over-imitation apparatuses. Six apparatuses in total were used (see Table 2). Four apparatuses were opaque and made of wood. Each had four sides, a bottom, and a lid held shut with a latch-type mechanism. The operation of the latch on the front of each apparatus allowed the lid to be opened. Two apparatuses were transparent. The transparent apparatuses were similar in design to the opaque apparatuses. Each had a wood frame but the sides and lids were clear glass. Each apparatus contained an object and was accompanied by a different tool (e.g. a stick or mallet). The tool was used to perform the causally irrelevant action. The unnecessary action was always produced on a part of the apparatus unrelated to the outcome to ensure that the causal irrelevance of the action was obvious. The tool was also used to perform the causally related action of operating the latch.

Procedure

Participants were seen individually to complete the experiment. See Table 5 for outline of procedure. Sessions took place at the Infant and Child Development Lab located on the University of New Brunswick Fredericton campus. Upon arrival at the lab, parents completed a consent form (Appendix I). The examiner and two research assistants interacted with the child and introduced him/her to the room where the tasks took place. This ensured that the child became familiar with all persons who were conducting the over-imitation tasks. Children and parents then completed different tasks in adjoining rooms. Parents completed the VABS-II, SRS-2, and a demographic information form. The order in which the parents received the SRS-2 and the VABS-II was counter-balanced among participants. Children were first administered the WASI-II. A 5-10 minute break occurred next. During the break, children had access to a number of toys and/or materials that aided in the behavioural observations necessary to complete the CARS-II. After the break, children completed the over-imitation tasks (as outlined below). The over-imitation tasks were followed by the memory task. At the end of the session, participants were given a debriefing letter (Appendix J) and $20.00 cash as compensation for participation. Each session took approximately 60-90 minutes and all sessions were video-recorded.

Over-imitation. There were three phases and two apparatuses used per phase. Each apparatus was used for one trial. Thus, children were given six over-imitation trials, with two trials in each phase (as outlined below). In each trial, the model(s) sat across from the child, modelled actions on the apparatus three times, and then gave the apparatus to the child with the instructions "your turn." Two apparatuses were included

in each phase to provide more behavioural data for analyses and to be consistent with previous research.

Phase I. The irrelevant model (E1) sat across the table from the participant and placed the first apparatus and tool on the table (trial 1). Picking up the tool, the model demonstrated the causally irrelevant action followed by the causally related action. The model opened the box, showed the participant the object inside, and closed the box out of the child's view. This was repeated two more times for a total of three demonstrations. Following the third demonstration, the model closed the apparatus and placed it and the tool on the table and said "Your turn" to the child. No request to copy the response was provided, nor were there instructions to do so. Children were given 60 seconds to respond, as necessary. Once the child had opened the apparatus, or the time had passed, the model removed the box. The same procedure was then repeated for the second apparatus (trial 2) for a total of two trials.

Phase II. This phase was similar to that implemented by Nielsen and Blank (2011). E1 left the room and two new models (E2 and E3), one irrelevant model (E2) and one efficient model (E3), joined the participant at the table. Both models demonstrated their respective actions on the same apparatus three times. Whether the irrelevant model or efficient model displayed their actions first was counterbalanced across participants. Following the demonstrations, children were randomly assigned to one of the two conditions. In one condition, the irrelevant model left the room (efficient-model-stays condition) and in the second condition the efficient model left the room (irrelevant-model-stays condition). The child was then given 60 seconds to open the apparatus (trial 1). Once the apparatus had been opened, or the time had passed, the

model removed the box and the second model returned to the room. The same procedure and condition was used for the second apparatus (trial 2) for a total of two trials. Participants were divided into the two conditions to allow for analysis of interactions based on the experimental manipulations.

Phase III. This phase involved the same irrelevant model (E1) from Phase I but this time the transparent apparatuses were used. Two trials were administered as in Phase I; the only difference in Phase III was that the apparatuses were transparent. The transparent apparatuses provided additional information about the irrelevant nature of the unnecessary actions because the inner workings of the apparatus were visible. To avoid participant's learning this additional information with transparent apparatuses and then applying that knowledge to an opaque apparatus, this phase always occurred last.

Coding

Coding of responses on the memory tasks was completed by E1 and inter-rater reliability coding was completed by E2 or E3 during test-administration. Coding of the over-imitation tasks was conducted from the video recordings. There were three over-imitation variables: causally irrelevant actions imitated, fidelity of causally irrelevant actions imitated, production of the causally related actions. The frequency of each action was counted (as per the definitions below). Because some data were missing, total trial scores were converted to percentages.

The first behaviour recorded was imitation of the irrelevant action that was modelled on the apparatus (referred to as the causally irrelevant action variable). To be coded in this category, the action performed by the child must have been on the same

surface area of the apparatus as displayed by the model. The child did not need to produce the same number of actions to receive credit in this category (i.e., if the model displayed three taps on the apparatus and the child only tapped once, the child still received credit for performing the irrelevant action). If the child added any subsequent actions other than that performed by the model, the child received credit in this category as long as the child first performed the irrelevant action in the same location as the examiner. Behaviours excluded from this category were: 1) if the child performed the same action but in a different location from where the model performed the action; 2) if the child performed a different action in the same or different location from the model; and 3) if the child performed an action other than that which the model displayed as their first action, even if this was followed by the same irrelevant action as performed by the model. Scores on this variable represent the percentage of trials in which participants imitated the irrelevant actions based on the number of codeable trials available for each phase.

The second behaviour recorded was the fidelity of the irrelevant actions (referred to as the fidelity of irrelevant action variable). Recall that each trial used a different apparatus. In Phase I, the model tapped the apparatus three times on trial one and swiped back and forth two times on trial two for a total of seven possible actions. In Phase II the model drew two circles on trial one and swiped back and forth one time on trial two for a total of four possible actions. In Phase III, the model tapped the apparatus two times on trial one and swiped back and forth two times on trial two for a total of six possible actions (see Table 2). Coders recorded how faithfully participants imitated these irrelevant actions. That is, they recorded how many taps, circles, or swipes the

participants made on each trial. To be counted as matching the experimenter's irrelevant actions, the actions by participants must have been the first action displayed by the child on the apparatus, and the action must have been performed in the same location of the apparatus. The number of actions produced by participants for codeable trials in each phase was combined and divided by the total possible number of actions to produce an overall fidelity percentage score for each phase. Higher percentages on this variable represent more faithful imitation.

Finally, participant's production of the causally related action on each apparatus was coded as having been produced using either the tool or hand. Of interest were the occasions where participants used their hands. Thus, scores on this variable represent the percentage of trials in which participants used their hands for each phase based on codeable trials available.

Modifications made to original project

Observations made early in the process of data collection revealed that children's responses in Phase II were not occurring as expected. Based on the findings from Nielsen and Blank (2011), it was hypothesized that TD children would include the irrelevant action only when the irrelevant model remained in the room whereas children with ASD would not produce irrelevant actions in either condition. However, after testing 17 participants, it was observed that both children with ASD and TD children were producing irrelevant actions in both conditions. Because Phase II always came after Phase I, it was not possible to determine whether this was due to a carry-over effect from Phase I. Further, the participants in this study were older than those tested by

Nielsen and Blank (2011). Thus, to better understand what was occurring with participants in Phase II, two modifications were made to the project. First, a second order was introduced (Order Two). In Order Two, Phase II was presented first, followed by Phase I and Phase III. Following the introduction of the second order, the remaining participants were randomly assigned to either Order One or Order Two until Order One was complete. The remainder were assigned to Order Two. A comparison between results from the original order (Order One) and Order Two allowed for determination of whether the unexpected Phase II results were due to carry over effects of being given Phase I prior to Phase II. Second, a stand-alone study (Study 2), comprised only of the Phase II procedure, was added using new TD participants. TD participants in Study 2 more closely aligned in age to those tested by Nielsen and Blank (2011). Thus, Study 2 was conducted to determine whether the findings from Nielsen and Blank (2011) could be replicated using the same procedure and participant age range. Study 2 is explored in more detail in Chapter 4.

Participant characteristics before and after modification

This section compares the characteristics of participants who participated prior to the modification (N = 17) and those who participated after the modification (N = 35) to explore for potential differences that may influence analyses and interpretation. All children who participated before the modification were in Order One, whereas those who participated after the modification were divided between Order One and Order Two. Characteristics were also examined separately for children with ASD before and after modification and TD children before and after modification. Categorical variables (i.e., group [ASD or TD children], sex, and demographic variables) were examined

using chi-square tests of independence, with $p < .05$ as the significance level. Continuous variables (i.e., age, perceptual reasoning, cognitive ability, communication, and social motivation) were examined with t-tests, with $p < .05$ as the significance level.

There were no significant differences on any of the demographic variables between participants who were run before and after modification, either in the sample as a whole or within the ASD or TD samples (see Table 6). Participants tested before the modification were significantly younger than participants tested after the modification. There were no significant differences in perceptual reasoning, communication, or social motivation (see Table 7). None of the other comparisons for the group as a whole reached significance. Looking at children with ASD and TD children separately, TD children participants run before the modification were significantly younger and had significantly lower perceptual reasoning scores than TD children run after the modification. There were no significant differences for any of the variables between children with ASD who participated before the modification and children with ASD who participated after the modification (see Table 7).

Participant characteristics in Order One and Order Two

Demographic characteristics and sex of participants in Order One and Order Two were compared using chi square test of independence, with $p < .05$ as the significant level. There were no significant differences on any of the variables (see Table 8). Participants in Order One and Order Two were also compared on age, perceptual reasoning, cognitive ability, communication, and social motivation using t-

tests with $p < .05$ as the significant level. There were no significant differences on any of these variables (see Table 9).

Summary of participant characteristic comparisons

Parents of TD children reported higher income levels and slightly higher maternal education levels than parents of children with ASD. In the group as a whole, participants tested before the modification were significantly younger than participants tested after the modification. Within groups, TD children tested before the modification were younger and had lower perceptual reasoning scores then those tested after the modification. More information about how age and perceptual reasoning will be accounted for in analyses will be provided in the results section.

Modifications to research questions and hypotheses

The first research question looked at why children with ASD would over-imitate and hypothesized that children with ASD would include the irrelevant action with the opaque apparatus (Phase I) and not with the transparent apparatus (Phase III) and would not include the irrelevant action in either Phase II condition. Order was included as an independent variable in the testing of these hypotheses. It was hypothesized that order would not have an impact on irrelevant actions in either Phase I or Phase III. On the other hand, order was expected to influence Phase II behaviour. It was expected that TD children would produce more irrelevant actions when the irrelevant model stayed compared to the efficient model and that children with ASD would produce low amounts of irrelevant actions in both conditions but only when Phase II came first. The second research question looked at factors that may relate to over-imitate and

hypothesized a positive relationship between over-imitation and communication, cognition, and social motivation. The order variable was included as a predictor in these hypotheses. The order variable was not expected to have an impact on the correlations or regression analyses.

Chapter 3

Results

Reliability

Reliability was completed on 20% of the sample by raters who were naïve to the hypotheses. Intraclass correlations (ICC), absolute type, with raters random were used for reliability. Raters random was selected for the ICCs because the raters were drawn from a larger population of possible coders. For both the verbal and nonverbal memory tasks, the ICC score was $r = 1.00$. ICCs were also determined for the three over-imitation variables. The ICC scores for the causally irrelevant actions variable in each phase and for trials in which participants used their hand for the related action in each phase were all $r = 1.00$. The ICC scores for the fidelity of irrelevant actions variable in Phase I was $r = .92$, in Phase II was $r = .83$, and in Phase III was $r = .89$. These scores represent excellent reliability.

Data Screening

One participant was missing data from one trial of two phases of the over-imitation task and one participant was missing data from one trial of one phase of the over-imitation task. To account for the missing data, percentages of trials were used rather than frequency data. Analyses on frequency data excluding these participants yielded the same results; therefore, only analyses on percentage of trials are included. All variables were analyzed for violations either of the assumptions of analysis of variance (ANOVA) or of regression analyses using the procedures outlined in Tabachnik & Fidel (2007). No univariate or multivariate outliers were detected on any

variables. Linearity and homoscedasticity were assessed via histograms, expected normal p plots, and detrended expected normal p plots, and all were acceptable (Tabachnik & Fidel, 2007). Non-normality was found for all Phases on the percentage of trials in which children used their hands to complete the related action variable. The skew values were outside of acceptable limits (z = -/+ 3.29; Tabachnik & Fidel, 2007). A review of the variables revealed the skew to be due to the majority of participants having 0% of trials in which they used their hands for the related action. The variables were not amenable to transformative attempts; therefore, the analyses were run on the original variable values. Multicollinearity was found between the perceptual reasoning variable and the cognitive ability variable (r = .92). The high correlation is likely due to cognitive ability being a composite variable that includes perceptual reasoning. Both were originally intended for use in regression analyses; however, perceptual reasoning is more relevant to the nature of the over-imitation tasks, which are nonverbal. General cognitive ability was removed and perceptual reasoning was retained a measure of nonverbal cognition. There were no further problems with multicollinearity. Singularity was absent on all variables.

Preliminary analyses

TD children tested before the modification to the design had lower perceptual reasoning scores then those tested after the modification (see Table 7). Importantly, there was no difference in perceptual reasoning between the two orders nor between children with ASD and TD children (See Tables 4 and 9). Further, all perceptual reasoning scores were within the average range (i.e., between 90-110) and, thus, the difference has minimal clinical significance. For these reasons, perceptual reasoning was

not included as a covariate in analyses of imitation of the irrelevant action, the fidelity of irrelevant actions, or the use of hands for the causally related action. Nonverbal cognition was included in the regression analyses.

Because of the broad age range of participants (6 to 16 years), the relationship between age and the predictor and dependent variables were explored using Pearson correlations and Spearman's Rho correlations. Parents of TD children had significantly higher income and marginally significantly higher maternal education than parent of children with ASD. To explore the potential impact of these sample differences on predictor and dependent variables, Spearman's rho correlations were conducted. Table 10 looks at the relationship between age, maternal education, and income and the predictor variables (i.e., order, nonverbal cognition, cognitive ability, social motivation, and communication). Table 11 looks at the relationship between age, maternal education, and income for each of the three dependent variables (i.e., imitation of irrelevant actions, fidelity of irrelevant actions, and use of hands for related action) for Phase I, each Phase II condition, and Phase III.

Age was not correlated with order. Age was related to the imitation of irrelevant actions and fidelity of irrelevant actions in Phase I and Phase III and in the Phase II condition where the irrelevant model stayed. Age was also negatively correlated with the use of hands for the causally related action in Phase I, Phase III, and when the efficient model stayed in Phase II. These results suggest that participants were less likely to include the irrelevant action, and more likely to use their hands, as age increased. Data were explored to ensure that older children were indeed over-imitating and graphs were created displaying the frequency of over-imitation by age and by group (Figure 1).

The figures demonstrate that, even with the significant correlations, older TD children and children with ASD did over-imitate.

Age was also positively correlated with nonverbal cognition and communication, suggesting that older children had better nonverbal cognition and communication. Given the significant correlations found between age and the imitation of irrelevant actions, and between age and other variables (i.e., nonverbal cognition, communication), and given that there were age differences between participants tested before the modification to the procedure versus after the procedure, age of participants was included as a covariate in subsequent analyses.

Maternal education was marginally correlated with the fidelity of irrelevant actions variable in the Phase II efficient model stays condition. Both maternal education and income were significantly correlated with social motivation. Given that the majority of correlations were non-significant and that social motivation will be explored in the regression analyses addressing research question two, no further action will be taken with maternal education or family income. Rather, the possible impact of these variables will be considered in the discussion.

Main analyses

Analyses were considered significant if the *p* value was less than or equal to .05. Age of participants was included as a covariate in all analyses.

Imitation of the irrelevant action. The first research question investigated whether children with ASD over-imitate because of a mistaken causal belief or for social reasons. It was hypothesized that children with ASD over-imitate because of

confusion about the causality of the irrelevant action, and not because of social motivation. To investigate the former, a 2 x 2 x 2 ANCOVA was conducted with group (ASD or TDC) and order (Order One = Phases I, II, III or Order Two = Phases II, I, III) as between-participants factors, Phase (I or III) as a within-participants factor. The dependent variable was the percentage of trials in which children imitated the irrelevant actions across apparatuses for Phase I and Phase III. Age was included as a covariate and was significantly related to the imitation of irrelevant actions ($F(1, 47) = 7.86$, $p < .01$, $\eta_p^2 = .14$). Results revealed a significant main effect of order ($F[1, 47] = 21.69$, $p < .001$, $\eta_p^2 = .32$). Participants who received Order One made significantly more irrelevant actions ($M = 81.92$, $SE = 6.62$) compared to participants who received Order Two ($M = 38.26$, $SE = 6.62$). There was no main effect of group ($F[1, 47] = .00$, $p = .94$, $\eta_p^2 = .00$), or phase ($F[1, 47] = .82$, $p = .37$, $\eta_p^2 = .02$). There were also no significant interactions between order and phase ($F[1, 47] = .03$, $p = .86$, $\eta_p^2 = .00$), order and group ($F[1, 47] = .27$, $p = .61$, $\eta_p^2 = .01$), phase and group ($F[1, 47] = .58$, $p = .45$, $\eta_p^2 = .01$) or between phase, group, and order ($F[1, 47] = .01$, $p = .91$, $\eta_p^2 = .00$; see Table 12).

To investigate the hypothesis that children with ASD were not over-imitating due to social motivation, a 2 x 2 x 2 ANCOVA was conducted with group (ASD or TDC), Phase II condition (irrelevant-model stays or efficient-model stays), and Order (Order One = I, II, III or Order Two = II, I, III) as between participant factors. Age of participants was included as a covariate and was significantly related to the imitation of irrelevant actions ($F(1, 43) = 11.63$, $p < .01$, $\eta_p^2 = .21$). The dependent variable was the percentage of trials in which children produced causally irrelevant actions. No significant main effects were found for order ($F[1, 43] = 1.86$, $p = .18$, $\eta_p^2 = .04$) or

Phase II conditions (F[1, 43] = .48, p = .49, η_p^2 = .01). Analysis revealed a marginally significant main effect of group (Children with ASD: M = 53.76, SE = 7.81; TD children: M = 33.70, SE = 7.82; F[1, 43] = 3.37, p = .07, η_p^2 = .07) and the group by Phase II condition interaction was significant (F[1, 43 = 4.18, p = .05, η_p^2 = .08; see Table 12). Post hoc analysis within groups revealed that children with ASD were marginally more likely to imitate the irrelevant actions when the efficient model remained in the room (M = 68.11, SE = 11.43) than when the irrelevant model remained (M = 38.70, SE = 10.60; F(1, 43) = 3.75, p = .06, η_p^2 = .08). While TD children made more irrelevant actions when the irrelevant model remained in the room (M = 40.79, SE = 10.59) than when the efficient model remained (M = 25.91, SE = 11.45), the difference was not significant (F(1, 43) = .91, p = .35, η_p^2 = .02). There were no significant interactions between group and order (F[1, 43] = .00, p = .97), order and Phase II condition F[1, 43] = .00, p = .95, η_p^2 = .00), or between group, order, and Phase II condition (F[1, 43] = .17, p = .68, η_p^2 = .00).

Exploration of order effect. To better understand the unanticipated significant order effect identified for the production of causally irrelevant actions in Phase I and III, the percentage of irrelevant actions produced during each of the three phases was explored according to the temporal ordering of phases. This temporal ordering was explored separately for each of the Phase II conditions and separately for each group (ASD or TD). Exploration of the order effect was done in two ways. First, graphs were created to provide a visual representation of each participant's behaviour by order, Phase II condition, and group. Figure 2 shows the response pattern for Order One, while Figure 3 shows the response pattern for Order Two. As Figure 2 demonstrates, children

who experienced Phase I followed by Phase II and Phase III showed a higher number of irrelevant actions in Phases I and III relative to Phase II. This pattern was particularly evident for the TD children. In contrast, Figure 3 shows that children who experienced Phase II first, followed by Phase I and Phase III do not demonstrate the same pattern as Order One and instead showed more variability in responding. The figures also demonstrate a generally lower level of responding in Phases I and III for Order Two compared to Order One. Finally, the figures demonstrate more variability in responding for the sample with ASD than the TD children in both orders, and this is particularly evident in Order Two.

The order effect was also explored using a 3 x 2 x 2 x 2 ANCOVA with temporal ordering of phases (Time: 1, 2, 3) as a within participant factor and group (ASD or TD children), Order (Order One or Order Two), and Phase II condition (irrelevant models stays or efficient model stays) as between participant factors. The dependent variable was the percentage of trials in which children produced causally irrelevant actions for each phase. Age of participants was included as a covariate and was significantly related to the imitation of irrelevant actions ($F(1, 43) = 12.15$, $p < .01$, $\eta_p^2 = .22$). There was no main effect of time ($F[2, 86] = .20$, $p = .82$, $\eta_p^2 = .01$), group ($F[1, 43] = .88$, $p = .36$, $\eta_p^2 = .02$), or Phase II condition ($F[1, 43] = 1.49$, $p = .23$, $\eta_p^2 = .03$). There was a main effect of Order ($F[1, 43] = 15.22$, $p < .001$, $\eta_p^2 = .26$) and a significant interaction between time and Order ($F[2, 86] = 7.49$, $p = .001$, $\eta_p^2 = .15$; see Table 13). There was no significant interaction between time and group ($F[2, 86] = 1.04$, $p = .36$, $\eta_p^2 = .02$) or Phase II condition ($F[2, 86] = .11$, $p = .90$, $\eta_p^2 = .00$). There were also no significant three way interactions between time, group, and Phase II

condition (F[2, 86] = .23, p = .80, η_p^2 = .01), time, group, and Order (F[2, 86] = 1.15, p = .32, η_p^2 = .03), or time, Phase II condition, and Order (F[2, 86] = 1.10, p = .34, η_p^2 = .03). Finally, the four-way interaction between time, Phase II condition, Order, and group was not significant (F[2, 86] = 1.70, p = .19, η_p^2 = .04).

The significant interaction between time and Order was further explored using linear and quadratic trend analyses. Even though there was no significant difference between groups, children with ASD and TD children were considered separately in order to understand the behavioural responses of children with ASD. Since there was no effect or interaction with Phase II condition, the subsequent analyses collapsed across this variable. For children with ASD, there was no linear or quadratic effect of temporal order of Phases for Order One (F[1, 11] = 1.27, p = .28, η_p^2 = .10; F[1, 11] = .36, p = .56, η_p^2 = .03, respectively) or for Order Two (F[1, 11] = .19, p = .67, η_p^2 = .02; F[1, 11] = .12, p = .92, η_p^2 = .00, respectively). Similarly, for TD children, there was also no linear or quadratic effect of temporal order of phases for Order One (F[1, 11] = .18. p = .68, η_p^2 = .02; F[1, 11] = 1.19, p = .30, η_p^2 = .09, respectively) or for Order Two (F[1, 11] = .08, p = .79, η_p^2 = .01; F[1, 11] = .01, p = .92, η_p^2 = .01, respectively).

In summary, the main effect of Order found in the statistical analysis was represented visually with less imitation of irrelevant actions in Order Two than in Order One. The significant time by Order interaction is also represented visually as a pattern of more irrelevant actions in Phase I and Phase III is evident in Order One but less evident in Order Two. The figures demonstrate greater variability in responding by children with ASD than TD children; however, there were no group differences statistically. That

there were no linear or quadratic effects for either group in either order may be due to high variability in responding as well as the small sample size for statistical analyses.

Individual patterns of behaviour. Binomial distribution tests were conducted to determine if the number of participants who imitated the causally irrelevant actions on at least one trial was significant. Analyses were conducted by group, separately for each order and phase.

Binomial distributions were examined for Phase I and Phase III. Looking at TD children in Order One, Phase I, 12 of the 13 participants made the irrelevant action and this was significantly different from chance (p = .00). Similar results were found for TD children in Order One, Phase III. Here, 12 of the 13 made the irrelevant action and this was significantly different from chance (p = .00). For children with ASD, 12 of the 13 participants in Order One, Phase I and Phase III, made the irrelevant action and this was different from chance (p = .00, p = .00, respectively). Considering Order Two, 7 of the 13 TD children in Phase I made the irrelevant action which was not different from chance (p = .21) whereas 10 of the 13 children in Phase III included the irrelevant action and this was significantly different from chance (p = 03). For children with ASD, 7 of 13 participants included the irrelevant action in both Phase I and Phase III and this was not different from chance (p = .21 for both phases).

Binomial distributions were also considered for the Phase II conditions. For TD children in Order One, 3 of the 6 participants included the irrelevant action when the efficient model stayed in the room and 5 of the 7 participants included the irrelevant action when the irrelevant model stayed in the room. Neither of these results were

significantly different from chance (p = .31 and p = .16, respectively). Similar results were found for children with ASD in Order One. Here, 5 of the 6 participants included the irrelevant action when the efficient model stayed and this was not significantly different from chance. (p = .09). Four of 7 participants included the irrelevant action in both trials when the irrelevant model stayed and this also was not different from chance (p = 0.27).

Looking at Order Two for the Phase II conditions, 3 of the 6 TD children made the irrelevant action when the efficient model stayed in the room and 3 of the 7 participants made the irrelevant action when the irrelevant model stayed in the room; neither was significantly different from change (p = .31 and p = .27, respectively). For children with ASD, 3 of 6 children included the irrelevant action when the efficient model remained in the room and 3 of 7 children included the irrelevant action when the irrelevant model stayed; neither result was significantly different from chance (p = .31 and p = .27, respectively).

Overall, both TD children and children with ASD were more likely to make the irrelevant action on at least one trial in Phase I and Phase III than to not make the irrelevant action when they received Order One. The same was not found for Order Two except for TD children in Phase III. Children's behaviour was not readily influenced by which model remained in the room in the Phase II conditions regardless of which order was received.

Fidelity. Analyses were conducted to investigate the extent to which participants faithfully imitated the irrelevant actions displayed by the model. Phases I, II, and III

were examined separately to account for the different number of maximum behaviours possible within each Phase. Age of participants was included as a covariate in each analysis.

For Phase I, a 2x2 ANCOVA was conducted comparing group (ASD or TDC) and order (Order One or Order Two). The dependent variable was the degree of fidelity with which participants produced the irrelevant actions in Phase I; the maximum number of actions was seven. Age was significantly related to fidelity ($F(1, 47) = 7.52$, $p < .01$, $\eta_p^2 = .14$). A main effect of order was found ($F[1, 47] = 21.63$, $p < .001$, $\eta_p^2 = .32$). Participants imitated the irrelevant actions with more fidelity when they received Phase I first ($M = 74.05$, $SE = 6.30$) than when they received Phase I second ($M = 32.61$, $SE = 6.30$). There was no main effect of group ($F[1, 47] = .14$, $p = .71$, $\eta_p^2 = .00$) and no group by order interaction ($F[1, 47] = .43$, $p = .52$, $\eta_p^2 = .01$).

The maximum number of actions for Phase II was four. A 2x2x2 ANCOVA with group, order, and Phase II condition (efficient model stays or irrelevant model stays) was conducted. Age was significantly related to fidelity ($F(1, 43) = 10.19$, $p < .01$, $\eta_p^2 = .19$). There was no main effect of group ($F[1, 43] = 2.99$, $p = .09$, $\eta_p^2 = .06$), order ($F[1, 43] = 2.24$, $p = .14$, $\eta_p^2 = .05$), or Phase II condition ($F[1, 43] = .26$, $p = .61$, $\eta_p^2 = .01$). There was a significant interaction between group and Phase II condition ($F[1, 43] = 4.83$, $p = .03$, $\eta_p^2 = .10$). Children with ASD were marginally more faithful in their imitation of irrelevant actions when the efficient model stayed (M = 62.78, SE = 10.55) than when the irrelevant model stayed ($M = 34.72$, $SE = 9.79$; $F[1, 43] = 3.68$, $p = .06$, $\eta_p^2 = .08$). In contrast, TD children did not differ in the faithfulness of their imitation of irrelevant actions across the two model conditions ($M = 22.22$, $SE = 10.57$ when the

efficient model stays; M = 39.29, SE = 9.77; F[1, 43] = 1.41, p = .24, η_p^2 = .03). There was no interaction between group and order (F[1, 43] = .11 p = .74, η_p^2 = .00), order and Phase II condition (F[1, 43] = .40, p = .84, η_p^2 =.00), or group, order, and Phase II condition (F[1, 43] = .75, p = .39, η_p^2 =.02).

A 2x2 ANCOVA comparing group and order was conducted looking at the degree of fidelity of irrelevant actions for Phase III (maximum number of actions was six). Similar to the other phases, age was related to fidelity (F(1, 47) = 4.80, p < .05, η_p^2 = .09). A main effect of order was found (F[1, 47] = 18.49, p < .001, η_p^2 = .28). Participants were more faithful in their imitation of the causally irrelevant actions in Order One (M = 73.74, SE = 6.96) compared to Order Two (M = 31.37, SE = 6.96). There was no main effect of group (F[1, 47] = .01, p = .93, η_p^2 = .00) and no order by group interaction (F[1, 47] = .21, p = .65, η_p^2 = .00). Thus, even though participants in both orders received Phase III as the last phase, meaning they each had been exposed to Phase I and Phase II manipulations prior to Phase III, there was still a difference found in how faithful they imitated based on which phase they first received.

Imitation of the causally related action. The second part of research question one considered the causally related action of using of the tool for opening the apparatus. The question was whether children with ASD would be more likely to use their hands compared to TD children when the irrelevant action was more obviously causally irrelevant. That is, it was hypothesized that children with ASD would use their hands more than TD children to open the box in Phase III, where the apparatuses were transparent but not in Phase I, where the apparatuses were opaque. It was also hypothesized that children with ASD would use their hands more than TD children in

both Phase II conditions, because the efficient model shows that the irrelevant action is not necessary. The dependent variable for these analyses was the percentage of trials in which children used their hands to complete the related action. Age was included as a covariate in analyses.

The first analysis looked at the percentage of trials in which participants used their hands for the related actions across apparatuses in Phase I and III. A 2 x 2 x 2 ANCOVA was conducted with group (ASD or TD) and Order (Order One = I, II, III; Order Two = II, I, III) as a between-participants factors and Phase (Phase I or III) as a within-participants factor. Age was significantly related to the use of hands for the causally related action ($F(1, 47) = 9.54$, $p < .01$, $\eta_p^2 = .17$). There was no difference in the use of hands for the causally related action between children with ASD and TD children ($F[1, 47] = 1.08$, $p = .30$, $\eta_p^2 = .02$) or between Order One and Order Two ($F[1, 47] = .04$, $p = .85$, $\eta_p^2 = .00$). Results revealed a marginally significant main effect of phase. Participants were marginally more likely to use their hands in Phase I ($M = 16.35$, $SE = 4.57$) compared to Phase III ($M = 9.61$, $SE = 3.52$; $F[1, 47] = 3.60$, $p = .06$, $\eta_p^2 = .07$). There was no group by phase interaction ($F[1, 47] = .03$, $p = .86$, $\eta_p^2 = .00$), group by order interaction ($F[1, 47] = 1.16$, $p = .29$, $\eta_p^2 = .02$), phase by order interaction ($F[1, 47] = .1.29$, $p = .26$) and no group by phase by order interaction ($F[1, 47] = 2.48$, $p = .12$, $\eta_p^2 = .05$).

The second analysis looked at the use of hands within the Phase II conditions. A 2 x 2 x 2 ANCOVA was conducted with group, order, and Phase II condition as between participant factors. Age was related to the use of hands ($F(1, 43) = 4.12$, $p < .05$, $\eta_p^2 = .09$). Similar to the comparison between Phases I and III, there was no difference in the

use of hands for the causally related action between children with ASD and TDC (F[1, 43] = .31, p = .58, η_p^2 = .01) or between Order One and Order Two (F[1, 43] = .00, p = .95, η_p^2 = .00). There was a main effect of Phase II condition (F[1, 43] = 6.52, p = .01, η_p^2 = .13). When participants used their hands for the causally related action, they were more likely to do so when the irrelevant model stayed in the room (M = 21.24, SE = 5.04) compared to when the efficient model stayed (M = 2.30, SE = 5.44). There was no group by Phase II condition interaction (F[1, 43] = .08, p = .77, η_p^2 = .00), group by order interaction (F[1, 43] = .26, p = .61, η_p^2 = .01), order by Phase II condition interaction (F[1, 43] = .94, p = .34, η_p^2 =.02) or group by order by Phase II interaction (F[1, 43] = .45, p = .51, η_p^2 = .01).

Factors that may relate to over-imitation. The second research question considered whether individual differences in over-imitation would be associated with nonverbal cognition, communication, and social motivation for Phase I and for the Phase II irrelevant-model stays condition. It was hypothesized that a positive relationship would be found between each of these variables and both the imitation of causally irrelevant actions variable and the fidelity of causally irrelevant action variable for both Phase I and the Phase II irrelevant-model stays condition. No specific predictions were made about the relative contribution of the variables to causally irrelevant actions or fidelity of irrelevant actions for either phase.

Using Phase I data, correlation analyses were conducted to look at the relationships between nonverbal cognition, communication, and social motivation and the imitation of causally irrelevant actions variable as well as the fidelity of irrelevant actions variable. Given the identification of an order effect in previous analyses, partial

correlations were examined that controlled for order. All analyses also controlled for age. A significant negative correlation was found between communication and imitation of irrelevant actions and communication and fidelity of irrelevant actions (see Table 14).

For the regression analyses using Phase I data, age was entered on the first step. The predictor variables (i.e., group, order, nonverbal cognition, communication, and social motivation) were entered on the second step. The first analysis used the imitation of causally irrelevant actions as the criterion variable. At step one, age contributed significantly to the regression model and accounted for 14% of the variation in imitation of irrelevant actions. Introducing the predictor variables in step two explained an additional 36% of variation in imitation of irrelevant actions and this change in R^2 was significant. Age, order of phase presentation, and communication were significant predictors in the final regression model (see Table 15). The second analysis used the Phase I fidelity of irrelevant actions variable as criterion and found similar results. At step one, age contributed significantly to the regression model and accounted for 11% of the variation. The predictor variables added in step two explained an additional 35% of the variance, with age and order being significant predictors and communication being a marginally significant predictor (see Table 16). In sum, older age, receiving phases in Order Two, and higher communication scores predicted imitation of fewer irrelevant actions and poorer fidelity.

Correlation and regression analyses were also conducted with the participants who received the Phase II condition where the irrelevant-model remained in the room (N = 28). Correlations were conducted between each of the imitation of causally irrelevant actions and the fidelity of irrelevant actions variables and nonverbal cognition,

social motivation, and communication. Given the identification of an order effect in previous analyses, partial correlations were examined that controlled for order. All analyses also controlled for age. There were no significant relationships between the imitation of irrelevant actions and the variables nor between the fidelity of irrelevant actions and any variable (see Table 17).

For the regression analyses using Phase II data, age was entered on the first step. The predictor variables (i.e., group, order, nonverbal cognition, communication, and social motivation) were entered on the second step. The first analysis used the imitation of causally irrelevant actions as the criterion variable. At step one, age contributed significantly to the regression model and accounted for 20% of the variation in imitation of irrelevant actions. Introducing the predictor variables did not significantly increase the amount of variance accounted for and age was no longer a significant predictor when the other variables were in the model (see Table 18). For the fidelity variable, the overall model was significant at step one with age being a significant predictor of 20% of the variance. Adding the remaining variables in step two did not significantly increase the amount of variance accounted for and none of the predictors were significant (see Table 19).

In summary, analyses did not support the hypotheses posed for the imitation of irrelevant actions, causally related actions, and possible predictors of over-imitation. Instead, the order in which phases were presented proved to be a key factor in behavioural responses. In particular, the findings for Phase II with the efficient and irrelevant models were not as predicted and did not support previous research. One possible reason for the unexpected results for Phase II could be that it was preceded by

Phase I; however, this seems unlikely given that the same non-significant results were found in Order Two where Phase II was presented first. Another reason could be due to that the age of participants. Participants here were older than those in Nielsen and Blank (2011). To determine whether this might be the case, an attempt was made to replicate Nielsen and Blank (2011) with participants similar in age. This additional study is described next.

Chapter 4

Study 2

To review, Nielsen and Blank (2011) investigated the causal belief theory and social affiliation theory of over-imitation by exposing their typically developing preschool age participants (four to five years of age) to two models who took turns opening an apparatus to retrieve an object. The irrelevant model opened the apparatus using causally irrelevant actions and related actions and the efficient model opened the apparatus using only the related actions. One model then left the room and the other remained and gave the child the apparatus to explore. Participants who were given the apparatus by the irrelevant model produced the irrelevant actions at a higher rate than participants who were given the apparatus by the efficient model.

The results found in Study 1 from the Phase II condition analysis in the main study did not replicate these findings; the overall production of causally irrelevant actions by participants who were given the apparatus by the efficient model was not significantly different from those who received it from the irrelevant model. Looking at just the TD children group in the main study also did not reveal any differences between the two conditions. The participants in the present study, however, were older than those in Nielsen and Blank (2011). To determine whether the findings from Nielsen and Blank are in fact replicable, and to better understand the results from the main study, a supplemental study was added to the main project using the same methodology and age range as that reported in Nielsen and Blank (2011).

Method

Participants

Participants comprised 36 TD children (17 males) four to five years of age (M = 57 months, SD = 3.83; Range = 49 months to 63 months). Participants were recruited through local daycare facilities. Children whose parents returned a signed consent form participated (Appendix K). Each child received a debriefing letter (Appendix L), stickers, and a small toy upon completion of the tasks and the child's name was entered into a draw for a 1 in 5 chance of winning a $20 Chapters gift card. The draw took place at the end of the study.

Parents completed a brief demographic form (Appendix G). According to the forms, 75% of parents reported being married, 11.1% reported being common law, 8.3% reported being legally separated, and 5.6% reported being single. Information about mothers was provided for all participants. All mothers identified as White/Caucasian. The modal education level for mothers was an undergraduate degree. Information about a father was provided for 89% of participants. The majority of fathers identified as White/Caucasian (97%) and 3% of participants identified as Aboriginal/First Nations. The modal education level for fathers was an undergraduate degree. The modal income level reported was +$120,000.

Procedure and experimental task

The study was conducted at local daycare facilities where children were recruited. A quiet room, separate from other children, was provided by the daycare

centre director. Children were brought individually to the room to participate. Each child sat across the table from the two examiners. The session was video recorded.

Participants watched two models demonstrate how to use a tool to operate the same opaque apparatus in order to retrieve a toy. The efficient model opened the apparatus using only causally related actions with the tool whereas the irrelevant model first modelled irrelevant actions with the tool followed by the same causally related actions to retrieve the toy. Which model went first and which apparatus was presented first were counterbalanced. Participants were then randomly assigned to one of three conditions. Two of these conditions were the same as that used in Study 1: the irrelevant model stays condition and the efficient model stays condition. To replicate the procedure used by Nielsen and Blank (2011), the third condition from their study was also used. In this condition, participants saw both models display the irrelevant action and causally related action and one model left the room (both irrelevant models condition). Each child saw the same procedure on two of the apparatuses that were used in Study 1 (yellow and orange, see Table 2).

Coding and reliability

Behaviours were coded from the video recordings by a research assistant naïve to the purpose of the project. Coding of the imitation of causally irrelevant actions and the fidelity of copying the causally irrelevant actions was the same as that outlined in Study 1. The score for the causally irrelevant action variable ranged from 0-2 and the fidelity score for the number of actions across apparatuses ranged from 0-5.

Reliability coding was done on 20% of the sample by a research assistant naïve to the hypothesis. Intraclass correlations (ICC), absolute type, with raters random were used for reliability. Raters random was selected for the ICC's because the raters were drawn from a larger population of possible coders. The ICC for the causally irrelevant action variable was $r = 1.00$ and the fidelity of irrelevant action variable was $r = .99$. These scores indicate excellent reliability.

Results and Discussion

There were no missing data from any trials so frequency data were used for the causally irrelevant action variable and the fidelity of irrelevant actions variable. There were no univariate outliers on either variable. Normality was assessed via skew and kurtosis values, histograms, expected normal p plots, and detrended expected normal p plots and all were within acceptable limits (Tabachnik & Fidel, 2007). An alpha level of $p < .05$ was used. The results of analyses are considered significant if the p value is less than or equal to .05. Because age was correlated with dependent variables in Study 1, the correlation between age and the imitation of irrelevant actions and fidelity of irrelevant actions was examined. There was no significant relationship between the imitation of the irrelevant action and fidelity of irrelevant action and age ($r = .07$, $p = .70$ and $r = .02$, $p = .93$, respectively).

A one-way ANOVA was conducted to examine the imitation of the causally irrelevant actions within the three conditions. Results found no effect of condition on irrelevant actions ($F[2, 35] = 1.88$, $p = .17$, $\eta_p^2 = .10$). This suggests that children's

actions on the apparatuses were not affected by the model that remained in the room (see Table 20).

Binomial distribution tests were conducted to determine if the number of participants who imitated the causally irrelevant actions on at least one trial was significant. Eight of the 12 participants made the causally irrelevant action in the efficient-model stays condition, which was not significantly different from chance (p = .12). In the irrelevant-model stays condition, 7 of the 12 children produced the causally irrelevant action; this was not different from chance (p = .19). These findings are similar to that found in the Phase II conditions of Study 1. Finally, in the condition where both models were irrelevant, 11 of 12 participants made the irrelevant action; this was significantly different from chance (p = .00).

The final analysis looked at the degree of fidelity with which participants imitated the irrelevant action as produced by the model. A one-way ANOVA was conducted using the three conditions. There was a significant effect of condition (F[2, 35] = 3.21, p = .05, η_p^2 = .16; see Table 21). Tukey post hoc analyses revealed participants to be marginally more faithful in their imitation of irrelevant actions in the condition with two irrelevant models than when the irrelevant model stayed (and efficient model left; p = .06). There was no difference in fidelity of the irrelevant actions between the efficient model remains condition and the irrelevant model remains condition (p = .86).

This finding is similar to that found in Study 1 where there was no main effect of Phase II condition on imitation of irrelevant actions and, in particular, no difference in

imitation of irrelevant actions for TD children between the two conditions. The results from the efficient-model stays condition and the irrelevant-model stays condition are similar to those found in Study 1. There continues to be no difference between these two conditions in the production of causally irrelevant actions. The findings from Study 2 also continue to not replicate the results found in Nielsen and Blank (2011). There was no difference in the production of the causally irrelevant actions or in the fidelity with which children copied the irrelevant action between the two the irrelevant model stays condition and the efficient model stays condition. Some of the results are consistent with that found in McGuigan and Robertson (2015) who replicated and expanded the Nielsen and Blank (2011) paradigm using peer models and 3 to 4-year old TD participants. McGuigan and Robertson (2015) did not find a difference in the imitation of irrelevant actions between the efficient-model stays condition and the irrelevant model stays condition. They reported that children made significantly more irrelevant actions in the conditions where both models demonstrated the irrelevant action. Here, participants were more faithful in the condition with two irrelevant models than when the irrelevant-model stayed (and the efficient model left), with a large effect size revealed, and participants imitated the irrelevant action at a level different from chance when both models demonstrated the irrelevant action.

Study 2 was compared to Nielsen and Blank (2011) in an attempt to understand what may have contributed to the different results. Several factors were considered. Participant characteristics appear to be fairly similar between the two studies. The same number of participants was used in each study, the number of male and female participants was almost identical, and participants were in the same age range. Nielsen

and Blank (2011) reported that all children were White. In the current sample, 97% of the mothers and 83% of fathers self-identified as White. The apparatuses used in both projects were similar. Nielsen and Blank (2011) had box-shaped apparatuses that were opened by releasing a switch mechanism. They were slightly larger than the apparatuses used here but both presented children with the same task – to use an object to manipulate a mechanism on the front of the apparatus (related action) which allowed the apparatus to open and reveal a hidden toy. Both studies used similar tools and similar irrelevant actions (e.g., circular swipes on the top of the lid). In terms of procedure, Nielsen and Blank (2011) reported that children were seated opposite two models; the same set-up was used here. The same three conditions were used in both studies and the procedure of irrelevant and related actions on the apparatuses was identical. No instructions other than "your turn" were given to children in either study. Thus, the procedures used in each project were very similar. Overall, non-replication of Nielsen and Blank (2011) has been found in the two studies conducted here.

Chapter 5

General Discussion

The purpose of this dissertation was to further our understanding of over-imitation behaviour in children with a diagnosis of ASD. The imitation of causally irrelevant actions has previously been explored with children with ASD and these children have been found to imitate irrelevant actions on opaque apparatuses to the same extent as children with Down syndrome (Nielsen & Hudry, 2010) and TD children (Nielsen et al., 2013). However, it was unclear from these studies whether the behaviour was due to children's confusion about the causality of the irrelevant actions on the apparatus or due to motivation to be social with the model. Over-imitation research conducted with TD children is more extensive and provided a paradigm to further explore over-imitation behaviour in children with ASD. A multi-phase experimental procedure (Study 1) was employed to examine the social and mistaken causal belief explanations of over-imitation in sample of children with ASD and TD children. In addition, communication, social motivation, and nonverbal cognition were examined to determine whether a relationship might exist between these variables and the imitation of irrelevant actions. A second study was conducted to further explore unanticipated findings that emerged from Study 1.

The first research question looked at why children with ASD may be over-imitating and hypothesized that children with ASD both included the irrelevant action, and used the tool for the causally related action, because they had a mistaken belief about the causality of these actions. It was hypothesized that the behaviour of children with ASD would be due to beliefs about the causality of the goal-directed action and not

based on social motivation. Thus, it was expected that children with ASD would include the irrelevant action, and use the tool for the related action, on the opaque apparatuses in Phase I, as this was found in previous literature. It was hypothesized that when the causal irrelevancy of the irrelevant actions was made more obvious with the transparent apparatuses in Phase III, and with the demonstration by the efficient model in Phase II, children with ASD would be less likely to include the irrelevant action, and more likely to use their hands for the related action, compared to TD children.

As expected, there were no group differences in the imitation of irrelevant actions or fidelity of the irrelevant action with the opaque apparatuses in Phase I and there was no effect. The imitation of irrelevant action finding replicates previous research, which has also found children with ASD to imitate irrelevant actions on opaque boxes to the same extent as TD children (Nielsen et al., 2013). Contrary to expectations, there were also no group differences in over-imitation (imitation of irrelevant action and fidelity of the irrelevant action) with the transparent apparatuses in Phase III; similar to Phase I, there was no effect. This finding extends the previous literature by providing the first evidence that children with ASD also include the irrelevant action when the apparatus is transparent and are doing so to the same extent as TD children. Because it is assumed that the irrelevancy of the non-causal actions is obvious with a transparent object, this argues against the over-imitation behaviour of children with ASD being based on mistaken beliefs about the causality of the irrelevant action.

Phase II conditions compared children's responses to an irrelevant model and an efficient model. It was hypothesized that children with ASD would be less likely to

include the irrelevant action than TD children in both of the Phase II conditions because the efficient model always demonstrates that the irrelevant action is not necessary. Previous research has found TD children to include the irrelevant action only when the irrelevant model stayed in the room (Nielsen & Blank, 2011). A significant interaction with medium effect size revealed children with ASD to be marginally more likely to imitate the irrelevant action when the efficient model remained in the room than when the irrelevant model remained. Children with ASD were also marginally more faithful in their imitation of irrelevant actions when the efficient model stayed then when the irrelevant model stayed. The fact that children with ASD imitated the irrelevant actions regardless of which model remained in the room suggests over-imitation behaviour for children with ASD is not driven by social motivation. However, the finding that children with ASD were marginally more likely to include the irrelevant action when the efficient model stayed is difficult to explain conceptually and warrants replication in order to rule out spurious effects.

In addition to positing hypotheses about conditions under which imitation of irrelevant actions would occur, the first research question also looked at the causally related action. It was hypothesized that when the irrelevant action was more obviously causally irrelevant (such as with the transparent apparatuses), children with ASD might use their hands more frequently to open the apparatus than TD children because these conditions also show that it is unnecessary to use the tool for the related action. Contrary to the hypothesis, no group differences were found in the use of hands in either of these conditions. Thus, children with ASD were not more likely to use their hands than TD children. This finding is consistent with previous research that found no differences in

tool use between children with ASD and TD with opaque apparatuses (Nielsen et al., 2013) and, again, extends the findings to transparent apparatuses.

The original design of this project was to have all participants receive Phase I first, followed by Phase II and then Phase III. However, in the early stages of data collection it was discovered that neither participants with ASD, nor TD participants, were systematically omitting the irrelevant action when the efficient model remained in the room. Since Phase II always followed Phase I, it was impossible to rule out the possibility that this was due to carry-over from Phase I. To better understand whether there was a carry-over effect from Phase I, the design was modified such that half the participants received the phases in the original order and half received them in the order of Phase II followed by Phases I and III. Order was included as a variable in all analyses and was found to have a significant influence on the imitation of irrelevant actions, and fidelity of irrelevant actions, for Phase I and Phase III with a large effect size being. Participants in Order One made significantly more irrelevant actions, and were more faithful in their imitation, in Phase I and Phase III than the participants in Order Two. There was no order effect found for analyses involving the Phase II conditions and the effect was small. There was also no effect of order for the imitation of the causally related action between Phase I and III or between the Phase II conditions; these analyses also had small effects.

This pattern of more over-imitation in Order One than Order Two was supported by visual examination of individual data of the three phases plotted temporally according to the order received. Furthermore, these visual representations revealed a pattern of higher imitation of irrelevant actions in Phases I and III than Phase II for

Order One but overall lower responding across all three phases in Order Two. Follow-up analyses confirmed the presence of an interaction such that the group that received Phase I first showed a different pattern of responding across the phases than the group that received Phase II first. Finally, the visual representations demonstrated greater variability in responding by children with ASD than TD children, particularly for those in Order Two.

Because Order was not a planned condition, and because the results were unexpected, it is important to rule out alternative explanations. To that end, it is important to note that there was no difference between participants who received Order One and those who received Order Two on demographics characteristics, chronological age, nonverbal cognition, communication, social motivation or cognitive ability. Thus, these factors cannot explain the order effect. An alpha of $p < .05$ was used here for all statistical analyses. This traditional alpha level accepts a 5% chance of a Type I error. Because of the large number of analyses, it is possible that some effects may be spurious. With a more conservative alpha (e.g., $p = .01$ or $p = .001$), the main effect of order identified for Phase I and III ($p < .001$) would continue to be significant. In contrast, a more conservative alpha would impact interpretation of the Phase II finding. Specifically, the finding that children with ASD made more irrelevant actions ($p = .05$) and were more faithful in their imitation ($p = .03$) in the Phase II condition where the efficient model remained in the room would no longer be significant. Given that these latter results were counter-intuitive, it is possible that they were spurious and future research should attempt to replicate them. Further, there were some group differences with small effect sizes that did not reach statistical significance based on the selected

alpha level. For example, in Order Two, looking at the binomial tests, significant numbers of children with ASD were not making the irrelevant action and continued to not include the irrelevant action into Phase III. In contrast, TD children in Order Two were not producing the irrelevant action at the beginning but were by Phase III. However, because the effects were small, there was high variability, and the sample size was small, these differences were not detected using statistical analyses.

It is also important to discuss whether other extraneous variables such as the demographics of the samples or age affected the results. In terms of demographics, differences in socioeconomic status (SES) were found. In particular, parents of TD children reported significantly higher income and marginally higher maternal education than parents of children with ASD. While not statistically different, more mothers and fathers of TD children worked full time and more mothers and fathers of children with ASD worked part time. These demographics suggest that the parents of children with ASD may have been from a lower SES group than the parents of the TD children. One might ask whether children of parents with lower SES may be expected to show differences in imitation. While research has not examined this question directly, SES is related to the development of language and cognitive ability (Letourneau, Duffett-Leger, Levac, Watson, & Young-Morris, 2011). Children from lower SES households tend to have lower cognitive ability upon school entry and tend to have lower achievement at school (Letourneau et al., 2011). Given that cognitive ability has been found to be related to imitation (Rogers & Williams, 2006) it is possible that children from lower SES households may show less imitation, and, by extension, less over-imitation, than children from higher SES households. However, the sample here had average cognitive

ability. Further, cognition, maternal education, and family income were not related to over-imitation in this study.

Another question regarding demographics is how children from lower SES families may have responded to the examiners in the project, and whether this may have influenced the findings. Familiarity with the examiner can improve performance on tests, particularly for children from low SES families (Sattler, 2008). However, the examiners here were equally unfamiliar with all participants; thus, it seems unlikely that familiarity impacted performance. If anything, this might suggest that the children with ASD would be at a further disadvantage. Finally, in terms of demographics, lower family income and maternal education for parents of children with ASD may be a reflection of the impact of having a child with ASD. Requirements for care, intervention, specialized appointments, and availability of appropriate childcare may reduce parents' ability to sustain paid employment, which reduces annual income (Cidav, Marcus, & Madell, 2012). Further, mothers of children with ASD are less likely to work and to work fewer hours than children with no health limitations (Cidav et al., 2012). Thus, the profile of this sample may be representative of the profile of families with a child with ASD. Given these considerations, it seems unlikely that the results found here for children with ASD are due to differences in income, education, or socioeconomic status.

Turning next to the age effects, it is important to consider whether the lack of support for hypotheses was because of the broad age range and the associated age effects observed. Age of participants in the main study was 6 to 16 years. Children with ASD between 4-8 years of age were found to over-imitate to the same extent as TD

children and it was believed that older children and adolescents with ASD would continue to show behaviour similar to same aged-peers. The relationship between age and dependent variables were considered and, unexpectedly, there were sufficient relationships to warrant controlling for age within analyses. Greater age was related to the imitation of fewer irrelevant actions, less fidelity of irrelevant actions, and more use of hands for the related action. A review of the data demonstrated that, even though older children made fewer irrelevant actions, they did still over-imitate. For example, results of the binomial distribution comparison indicate that, at least for Order One, almost all of the participants imitated the irrelevant action. This suggests that non-significant results were not due to a lack of over-imitation from older children. Further, as noted above, the effect of age was controlled for by including it as a covariate in all analyses. Thus, the significant effects (particularly the order effects) found here exist beyond any error variance associated with age.

Having considered the potential influence of extraneous variables, we now explore the possible theoretical explanations for the data, beginning with the mistaken causal beliefs theory. The relatively higher responding of irrelevant actions with opaque apparatuses in Phase I, compared to the drop in responding to the opaque apparatuses in Phase II, for the Order One participants could be due to mistaken beliefs about the causality of the irrelevant action and need to use the tool. In Phase I, participants may have held a distorted causal belief regarding the irrelevant action and included the irrelevant action. The belief about the irrelevant action could have been clarified with the presence of the efficient model in Phase II which would have led to a drop in the irrelevant actions. However, this would not explain the resurgence of irrelevant actions

that occurred when participants in Order One were presented with the transparent apparatuses in Phase III. Once participants were shown that the actions were irrelevant in Phase II, their reproduction of irrelevant actions should have remained low, especially since they could now see through the transparent apparatuses. Similar arguments can be made for the use of the tool for the causally related action. Once the children could see with the transparent apparatuses that the tool was not required to open the apparatus, they should have switched to using their hands.

The social explanation for over-imitation posits that participants would include the irrelevant action in order to be like, or affiliate with, the model. This explanation predicts that participants in *both* Order One and Order Two would include the irrelevant actions in *all* phases in order to be like the model *except* for when the efficient model remained in Phase II. When the efficient model remained, participants should have omitted the irrelevant action in order to align with what this model demonstrates. That this was not the case for participants in either order argues against a social explanation for the over-imitation. Further, the social explanation cannot explain why participants in Order 2 would produce less irrelevant actions than those in Order 1, since, presumably, participants would have no reason to be more or less social with the models with one order of presentation versus another. Again, similar arguments can be made for the use of the tool for the causally related action: The models in each phase/condition used the tool for the causally related action and the participants used the tool in each of those conditions. This could suggest that participants were using the tool to be social. However, if they were trying to be social by using the tool in imitation of the model, it is difficult to understand why they would continue to imitate the *irrelevant* actions in

Phase II when the efficient model (who did not demonstrate irrelevant actions) remained in the room. Finally, the participants may have produced more irrelevant actions in Phases I and III because the same model demonstrated the actions in these two phases. However, this does not explain the low level of responding in Phases I and III of Order Two with the same model present, nor does it explain the drop in responding from Phase I to Phase II in Order 1, since the models would have been equally unfamiliar at the start of both of those phases.

Another possible reason for participants to produce irrelevant actions is because they thought that they were playing a game with the model. Under this supposition, participants' behaviour would vary according to the conditions of the current study because they would have been attempting to determine the rules of the game. In Phases I and III, the rules would be clear, since only one model demonstrates opening the apparatuses, and she always uses irrelevant actions. In contrast, in Phase II, two models are present, one of whom models the irrelevant actions and one of whom does not. In this phase, the rules become less clear. Using this reasoning, participants should have produced high levels of irrelevant actions in Phases I and III but lower levels of irrelevant actions if Phase II, regardless of the order of demonstration of phases. There would be no reason for the production of fewer irrelevant actions in one order versus another. That the order of phases had an impact on participants' responding suggests that there is more behind over-imitation than the participants simply thinking that they are playing a game.

Given that the results do not support either the mistaken causal beliefs or the social motivation theories or simpler alternatives such as a familiarity effect or a belief

that the participants are playing a game, it is necessary to re-examine the normativity theory which was reviewed briefly in the introduction. The normativity theory proposes that children think the irrelevant actions need to be, or ought to be, reproduced because they are essential, conventional components of the sequence (Kenward, 2012; Keupp et al., 2013). The normativity explanation was ruled out at the implementation of this project because normativity did not explain why children in previous research would selectively follow an irrelevant or efficient model based on who remained in the room, after seeing that they both successfully manipulate an apparatus (Nielsen & Blank, 2011). Instead, over-imitation based on which model was present suggested that over-imitation was performed to be social with the examiner. Further, given the inherent social deficits of ASD, a social explanation seemed unlikely to explain the over-imitation observed in children with ASD, and so it was important to rule out the social explanation.

The normativity theory provides an interesting explanation for the order effect found here. Viewing the irrelevant-action/relevant-action sequence with opaque apparatuses in Phase I for participants in Order One may have set up an expectation (i.e., a norm) that the model makes unnecessary actions as part of the action sequence with apparatuses. Participants may have included the irrelevant action because they thought the action was an essential component of the procedure. In Phase II, one of the models included the unnecessary actions but the other model did not. Seeing the apparatus manipulated in two ways may have disrupted the formation of a conventional norm, in effect, confusing the children as to what the normative behaviour should now be. Thus, one model 'violated' the norm. Here, results show a significant drop in the inclusion of

irrelevant actions compared to Phase I. However, some participants did continue to make the irrelevant actions. Thus, participants may have been unsure about what the norm was and, hence, some over-imitated while others did not. In fact, the standard error for Order One participants in Phase II was higher than in Phase I, supporting this notion. When participants subsequently took part in Phase III with the transparent apparatuses, they saw one model once again use the irrelevant action in the action sequence to complete the task. Here, there was a significant increase in the production of irrelevant actions by participants, to the same level as in Phase I. This may have been due to participants again considering the irrelevant actions as the normative behaviour (as it was in Phase I). Further, Study 2 found that participants were significantly more likely to make the irrelevant action when both of the models demonstrated the irrelevant actions, suggesting that when both models demonstrate the same action, it is easier to learn a norm (McGuigan et al., 2015). With Order Two, Phase II occurred first. Because the efficient model demonstrated to participants that the irrelevant action was not causally necessary, this phase may have set up a normative expectation from the beginning that the irrelevant actions were not necessary. Or, it is possible that the presence of the two models in Phase II created confusion about what was in fact the normative behaviour for manipulating the apparatuses.

The normativity theory may also help explain the unexpected interaction where children with ASD were more likely to imitate the irrelevant action, and were more faithful in this imitation, when the efficient model remained in the room compared to when the irrelevant model stayed. The normativity theory suggests that children interpret the irrelevant action as an essential component of the sequence. The interaction

suggests that children with ASD not only made this interpretation but adhered to it even when a model violated the norm, as the efficient model does. However, it is important to consider the pattern of results. First, there was less overall imitation of irrelevant actions in Phase II compared to the other two conditions and there was no effect of order found for Phase II. This means that participants were less likely to imitate the irrelevant action in this Phase and, when children with ASD did include the irrelevant action in the presence of the efficient model, they did so regardless of the order received. Considering Order One, the norm that the irrelevant action is part of the action sequence is formed with Phase I. Some children with ASD may have continued to include the action in Phase II regardless of which model remained due to inflexibility in thinking and the tendency to perseverate. However, questions arise with Order Two where Phase II is presented first. It is unclear why participants who first observe the two models would make the assumption that the irrelevant action is the normative behaviour. It could be just as likely that the normative behaviour is to use the efficient method. Further exploration of how children with ASD come to understand normative behaviour and their adherence to learned norms would be informative.

Regardless of the reasoning, the way the task was introduced at the beginning of the experiment appeared to have an impact on how children interpreted the task, and this interpretation appeared to be carried through the rest of the phases. Recent research has shown that how a task is framed prior to the child being given a turn with the apparatus has an impact on how children interpret, and subsequently complete, the task. In particular, research has varied the extent to which the actions demonstrated are presented as conventional/normative or instrumental (Moraru, Gomez, & McGuigan,

2016). Conventional cues indicate that the action should be performed in a particular manner. Instrumental cues indicate that an observer is to complete a goal (Hermann, Legare, Harris, & Whitehouse, 2013). For example, Moraru et al. (2016) manipulated the pre-demonstration instructions in an imitation task to include either a conventional solution (i.e., "I will show you how to get the toy out) or an instrumental solution (i.e., "I will you show one way to get the toy out"). Moraru et al. (2016) found children were more likely to imitate the irrelevant action with a conventional introduction than with an instrumental introduction.

For the current project, it is possible that Order One, which began with a single model in Phase I, suggested a conventional context to participants. That is, children were instructed to "watch me" and the task was demonstrated with irrelevant and related actions. It is possible that the children interpreted this demonstration as intending to demonstrate how the actions should be performed. In contrast, the type of context suggested by Order Two, which began with two models in Phase II, may have been an instrumental context. That is, children were shown that there was more than one way to get the toy out. Thus, the task may have been interpreted as outcome oriented. Moraru et al. (2016) compared over-imitation in a conventional and instrumental context and found more imitation of irrelevant actions in a conventional context. This is consistent with over-imitation results for the two orders found here; that is, there was more imitation of irrelevant actions in the conventional context created by Order One than in the instrumental context created by Order Two. Further, the context created by the *first* phase participants experienced set the stage for responding within the other two phases and this differed by order. Again, Order One set up a conventional context and imitation

was observed in Phase I. There was a drop in imitation of irrelevant actions when participants were given Phase II. When this phase is viewed as an instrumental context, the lower responding is understandable. When a single model returned in Phase III, and thus returned to a conventional context, there was an increase in imitation. However, and critically, Order Two set up an instrumental context and this context remained even when Phase I and III were demonstrated. Thus, even though Phase I and III have a conventional context, when participants were first given Phase II, the outcome oriented nature of the tasks was held for subsequent responding in the other two phases. The finding that a communicative context can influence how children interpret an over-imitation task may also explain why the results from Study 2 differed from those of Nielsen and Blank (2011). Given the research suggesting that young children are sensitive to subtle differences in the context in which an experience is framed (i.e., normative/conventional or instrumental), it is possible that there were subtle differences in the communicative context that are not accounted for and that may have contributed to the varied results.

Finally, while a normative explanation and task introduction support the varied pattern of behavioural results shown with the order effect, it is important to consider what other factors may determine what children learn and how they subsequently act. For example, Study 1 was conducted in a laboratory setting on a university campus with adult models. The procedure was such that the examiner led the activities. Anecdotally, this is similar to the teacher-student and child-directed interactions common in Canadian school systems. It is possible that children over-imitated because the tasks were directed to them and that the lower amount of over-imitation in Phase II was due to the two

models confusing children about what to do. One could assume that direction would have been more clear in Phases I and III because of the presence of a single model. However, if participants were "doing as they were told" because of the child-directed nature of the task, then they should have included the irrelevant actions in Phase I and III in both orders. Further, research has found that child-directed interactions are not sufficient in and of themselves to explain how children learn from others and that factors such as social motivation or social relevance or value of the message, seeing multiple people perform in a conventional way, observation of people in one's culture (Shneidman & Woodward, 2016), and the introduction of the task, as outlined above, may all be relevant for explaining how children learn from others. Manipulation of these factors may further elucidate the nuances of over-imitation behaviour in children with ASD.

The second research question investigated whether nonverbal cognition, communication, and social motivation would be associated with individual differences in the production of causally irrelevant actions, and with fidelity of irrelevant actions, in Phase I as well as in the Phase II irrelevant model stays condition (where the irrelevant model remained in the room). It was hypothesized that a positive relationship would be found between the imitation of irrelevant actions and each of nonverbal cognition, communication, and social motivation, as well as the fidelity of irrelevant actions and each of those variables, in both of these phases. All analyses included order and age. Younger age, Order One presentation of phases, and lower communication scores predicted the imitation of more irrelevant actions, and higher fidelity of irrelevant actions in Phase I with opaque apparatuses. Age was the only significant predictor of

imitation in the Phase II irrelevant model stays condition. Diagnostic group did not predict imitation of irrelevant actions.

The finding that higher communication scores predicted less imitation of the irrelevant action and less faithfulness of the imitation is not consistent with existing literature (Nielsen & Hudry, 2010). Methodological differences between the studies make direct comparisons between the studies difficult. However, one possible explanation for the differences may relate to participant characteristics. The current study had a larger age range and included older participants than those in Nielsen and Hudry (2010). Whereas Nielsen had Hudry (2010) did not find a relationship between age and over-imitation, older age was associated with less imitation in the current study. Furthermore, older children had lower communication scores in the current study. It is possible that a complex relationship exists between age, communication ability, and over-imitation that warrants further investigation.

The lack of relationship between the imitation of irrelevant actions and cognition is inconsistent with reports of positive relationships between cognitive ability and imitation (Rogers & Williams, 2006). The group of children here can be described as cognitively able and, in retrospect, there was limited variation in cognitive ability in the group of children with ASD. Nielsen et al. (2013) attributed over-imitation in their sample of children with ASD to the group being cognitively able. Thus, at least within the average range, over-imitation appears not to be related to cognition. An avenue for future research may be to look at a broader range of cognitive functioning and determine whether a relationship exists with over-imitation.

Contrary to hypotheses, there was no relationship between social motivation and the imitation of causally irrelevant actions. This finding is congruent with the lack of support for the social affiliation explanation of over-imitation found in the two studies conducted here and suggests that children's display of over-imitation is not based on motivation to affiliate with or be like the model. Instead, it may be that another social aspect, such as social responsivity, may be a more relevant factor. Increased social responsivity has been found to be positively related to imitation skills in children with ASD (Rogers et al., 2003). Rogers et al. (2003) based social responsivity on direct observation of children's social orienting and responsiveness to a partner, such as facial expression and vocalizations directed to others, the integration of eye contact with these behaviours, shared enjoyment, and the initiation of social overtures. Thus, it is possible that a child's responsiveness to, and engagement with, an examiner may be more relevant for over-imitation than social motivation per se. Nevertheless, it also remains possible that over-imitation is not explained by a social theory. Assuming that normativity explains the over-imitation observed here, and that the irrelevant action is considered as a part of the conventional sequence of actions, the irrelevant action could be expected to be reproduced irrespective of a child's level of social motivation.

Implications

The research findings have both theoretical and practical implications in our understanding of over-imitation for children with ASD. In terms of theoretical implications, the overarching perspective supported here was the normativity account of over-imitation. From this perspective, children acquire a norm to complete the task using the entire sequence of actions demonstrated by the model. This conceptualization

is consistent with the description of over-imitation as a strategy that allows for cultural learning to occur (Legare & Harris, 2016). At its foundation, cultural learning involves learning from another person. It is learning that occurs during interaction and communication with other people where one acquires information about cultural beliefs, norms, and rituals, as well as practical skills (Tomasello, 2016). Cultural learning has much significance from an evolutionary perspective – the capacity for such learning has supported the evolution of human cultural practices (Tomasello, 2016). The cultural learning framework provides an explanation for the fact that over-imitation, at first glance, appears counter-intuitive. In over-imitation, children interpret all actions made by the model as normative, conventional components of the task. Thus, copying unnecessary actions is strategic and adaptive because it allows an individual to acquire idiosyncratic, and often opaque, cultural information (Flynn & Smith; 2012; Legare & Harris, 2016). Nielsen et al. (2014) posit that if over-imitation has been adaptive from an evolutionary perspective, it would be expected to be present in diverse cultural environments. Over-imitation has now been found in populations from Westernized countries (e.g., Canada, Australia) as well as children raised in remote Kalahari Bushman communities of southern Africa (Nielsen & Tomaselli, 2010) and with Australian Aborigines (Nielsen et al., 2014). Over-imitation has also been found with TDC, children with Down syndrome, and children with ASD (Nielsen & Hudry, 2010; Nielsen et al., 2012).

The finding of no group differences in Phase I and Phase III fits with the idea that imitation can serve two functions: the social function and the cognitive-apprenticeship function. The over-imitation tasks used here would be classified in the

cognitive-apprenticeship function of imitation because the tasks involved learning about goal-directed actions on objects. Children with ASD imitate object-directed actions and perform better on tasks in the cognitive apprenticeship function of imitation than in the social function (Rogers et al., 2010; Williams et al., 2004). Over-imitation can be added as one more object-directed imitation task that children with ASD can perform.

An important implication of the results here is that children with ASD appear to be influenced by subtleties in the communication context of the over-imitation task, as evidenced by the differences in responding between the two orders of task administration and the lack of differences between children with ASD and TD children. That is, children with ASD seemed to have inferred either a conventional or informational context and adjusted their behaviour accordingly. Because of the social difficulties experienced by children with ASD, this might seem unusual. However, given children with ASD's facility with tasks that serve a cognitive-apprenticeship function, it is possible that they could learn that a particular sequence of goal-directed behaviour is "just the way we do it" without wanting to please or be like the examiner (Keupp et al., 2013; Over & Carpenter, 2012b).

A distinction between normativity conformity and informational conformity may be helpful here (McGuigan & Robertson, 2015). Informational conformity has to do with solving a problem using a reliable strategy whereas normative conformity has to do with imitating an approach or pattern of behaviour for social reasons (Haun, van Leeuwen, & Edelson, 2013). It is possible that children with ASD may over-imitate for normative reasons based on informational conformity rather than conformity that has social underpinnings. One way this has been explored in over-imitation with TD

children was to allow children to have a final turn, in private, with the apparatus after being led to believe that the experiment was over. McGuigan and Robertson (2016) suggest that, if children over-imitate in the presence of the models and then fail to include the irrelevant action in private, then the initial over-imitation may have been based on normativity conformity to be social. McGuigan and Robertson (2016) found a significant reduction in imitation of irrelevant action by children in the final, private condition compared to experimental phases. Such an experiment conducted with children with ASD may distinguish what type of confirmative behaviour they have learned. If, after learning a normative behaviour, they continue the behaviour in private, this would suggest that over-imitation is based on information conformity. If they do not continue the behaviour, it would suggest that over-imitation is based on normativity conformity.

The results here may also have important practical applications for designing intervention programs for children with ASD. For example, children with ASD tend to be rigid and rule-bound (Volkmar et al., 2014). These features make it difficult to teach children new ways of interacting with objects, since they may persist in doing things the same way over and over, even when it is not adaptive. If one wants to teach goal-directed behaviour and reduce rigidity, then using cues to create a conventional framework (e.g., insisting that a child "do this", having multiple models/therapist all demonstrating things the same way, using multiple demonstrations) may be counter-productive since this suggests to the child what there is only one (conventional or "right") way to accomplish the goal. In contrast, using cues to create an instrumental

framework (suggesting this is *one* way to do it, demonstrating multiple ways to complete the task) may be more productive.

Strengths and Limitations

The present study contributes to, and expands, the literature on understanding over-imitation in children with ASD in several ways. First, the sample of children with ASD and TD children were matched on chronological age, perceptual reasoning, cognitive ability, and verbal comprehension. The well-matched nature of the groups means that any differences between groups would not have been due to these factors.

A second strength was that the methodology included an assessment of memory and motor skills. Over-imitation tasks, by nature, rely on short-term memory, and involve a fine motor element. All participants were administered a verbal and nonverbal short-term memory task, and both were successfully completed by all participants. Parents indicated that all participants had fine motor skills sufficient to complete the over-imitation tasks; however, it is important to remain cognizant of the motor impairments that often accompany ASD (McPhillips, Finlay, Bejerot, & Hanley, 2014). It is possible that some element of motor impairment that was not assessed here may have contributed to the responses by children with ASD and this should be considered in future over-imitation research.

A third strength of this project was the inclusion of stand-alone Study 2. Study 2 was conducted to better understand the non-significant results from Phase II of Study 1, and was a replication of Nielsen and Blank (2011). The results from these two studies provide two instances of non-replication of Nielsen and Blank (2011). That Study 2

replicated Study 1 suggests that the lack of difference between the two Phase II conditions in Study 1 was not a result of carry-over from Phase I.

Age presented as both a strength and limitation. The age range used here extended that in previous research. In previous literature, children with ASD had been studied up to the age of 8 years and TD children up to the age of 13 years (Nielsen et al., 2013; Nielsen & Tomaselli, 2010). This is the first study to include adolescents aged 13 to 16 years of age in over-imitation research. Thus, the current study contributes to the literature by demonstrating that older children and teenagers with ASD over-imitate and do so to the same extent as same-aged TD peers. Results also found that imitation of irrelevant actions decreased with age. Some over-imitation research with TD children suggests that over-imitation increases with age (McGuigan et al., 2011; Nielsen & Tomaselli, 2010) while other research that included a sample of children with ASD suggests no changes with age (Nielsen & Hudry, 2010). Given that these studies have used different age groups, and no children in the adolescent age range, it is difficult to make comparisons to the results found here. Results here need to be replicated to better understand how age and the imitation of irrelevant actions relate to each other. Another limitation of the broad age range is the age effect which needed to be controlled for statistically. There was also not a large enough sample to look at differences within age groups.

An important limitation of the project is the within-participants design. Initially, all participants in Study 1 were to receive phases in the order of Phase I followed by Phases II and III. However, preliminary analysis indicated unexpected findings in Phase II. Specifically, participants were not omitting the irrelevant action when the efficient

model remained in the room, as found in previous research by Nielsen and Blank (2011). Because Phase II was preceded by Phase I, it was not possible to know if the unanticipated Phase II results were due to the within-subject design or to another reason. Consequently, a second order of phases was included, where Phase II occurred first (i.e., Order Two: Phase II, I, III). This allowed for a more complete assessment of responses by participants in Phase II and of the social theory of over-imitation; however, it also introduced potential sources of error into the design.

To account for some of those potential sources of error, careful examination of the participants tested before the modification and after the modification was undertaken. This examination revealed no differences on the majority of variables. However, children tested before the modification were younger than those who were tested after, and TD children tested before the modification had lower perceptual reasoning than those tested after the modification. Importantly, there were no group differences on these variables across Order or diagnostic group. This suggests that any differences between participants based on timing of recruitment (i.e., before or after the modification) was equally distributed across the two orders and the two diagnostic groups.

Another limitation of the within-participants research design is that the opaque apparatuses (used in Phase I and Phase II) were always presented prior to the transparent apparatuses (Phase III). Previous research using a within-participant design found that the order of presentations of opaque and transparent apparatuses did not impact whether participants imitated the irrelevant actions (Horner & Whiten, 2005). Thus, it is unlikely that the results here are due to the order of presentation of opaque versus transparent

apparatuses; however, given that the reverse order of apparatuses was not included, this is speculative. It is important that future over-imitation research be cognizant of the research design being used (e.g., within-subjects design versus a between-subjects design) in relation to the explanations being investigated. Thus, studies that expose participants to more than one experimental manipulation of over-imitation tasks would need to include the possibility of a learning effect when interpreting results.

A potential limitation is that anxiety or other mental health issues were not assessed. The over-imitation tasks were interactive between the model and participant and involved the participant manipulating the apparatuses with tools, which could be construed as a performance activity. If a participant experiences anxiety in such situations, it may have subsequently impacted their performance on the over-imitation task, such as through attention to the activity or imitation of the actions. It may be useful for future research to screen for anxiety to determine whether it may account for any variance in imitation.

Finally, another methodological limitation of this project is that children were not given an opportunity to manipulate the apparatuses prior to the experimental procedure. A baseline phase would have allowed for increased confidence that the use of the tool was done in imitation of the model. A baseline phase would also have shown whether prior experience with the apparatuses affected subsequent imitation of irrelevant actions. Nielsen et al. (2012) found that 4-year-old children who had previous experience with the apparatus were as likely to use the tool and perform the unnecessary action as children who had not had any prior experience with the apparatus. They further found that participants used a tool to imitate the irrelevant action demonstrated by a

model even after they had successfully opened the apparatus on their own with their hands prior to any demonstration (Nielsen et al., 2012). This suggests that prior opportunity to manipulate the apparatus would not have changed the children's behaviour. However, because the children in Nielsen et al. (2012) were younger than the children tested here, the inclusion of a baseline exposure phase would be an important component of future over-imitation research with children with ASD.

Directions for Future Research

This is the first study of over-imitation in children with ASD between eight to 16 years of age. Replication studies using this age range would provide further confidence about the conclusions regarding over-imitation skills in this age group. Another direction for future research would be to vary the cognitive levels of the children with ASD included in the project. Cognitive ability as measured here was not found to relate to the imitation of irrelevant actions. It remains to be seen whether a larger variance in cognitive ability would relate to, or predict, over-imitation.

Age of participants in over-imitation tasks is an important area for future research. Including participants who are older (e.g., adolescent age range) will serve to replicate the results here. Another area to explore would be whether the context in which an over-imitation task is presented is related to age. Moraru et al. (2016) found that older children in their sample of 3-to 6-year old TD children over-imitated irrespective of the conventional or instrumental context whereas the youngest children were more likely to over-imitate only within the conventional/normative context. Age of participants was not related to the order of phases here and thus was not related to the

contextual framework of the task. Because the age range of this study is so different than Moraru et al. (2016) it is difficult to make comparisons and warrants further research.

A second area of exploration would be whether adolescents would be more likely to over-imitate if the model was a peer and if more than one peer model were present. Some research has compared adult to child models using both 3- to 5-year old participants and adult participants (McGuigan et al., 2011). They found all participants to imitate an adult model more frequently than a child model. Research using peer models found 3- to 4-year old TD children to imitate their peers (McGuigan & Robertson, 2011). Further, children were more likely to imitate irrelevant actions when the two models present both demonstrated an irrelevant action than when only one of two models demonstrated the irrelevant action and that children switched to over-imitation when they were exposed to additional peer models who demonstrated the irrelevant action. This finding supports a conventional/normativity explanation for over-imitation – that is, children were more likely to conform to the norm of including the irrelevant action with more peer models present (McGuigan & Robertson, 2011). It is uncertain whether adolescents would preferentially imitate a peer model versus and adult or whether they would imitate an irrelevant action if it were demonstrated by all peer models present. Research has demonstrated the influence of peers on a variety of adolescent behaviours (Bell & Baron, 2015; Berndt, 2004). Future research should include peer models with samples of children including adolescents to explore how the normativity theory and context of task presentation may relate to over-imitation and age.

Some research has used participants' verbal responses to evaluate theories of over-imitation. Previous research investigating the normativity theory explored verbal

responses of participants when a puppet omitted the irrelevant action and found children to often protest the omission of the irrelevant action; this was highlighted as supporting the normativity explanation because the protest suggests children thought the action should be included as part of the sequence of behaviour. (Kenward, 2012; Keupp et al., 2013). Other research has queried participants about the motives of their behaviour. In Kenward et al. (2011), TD children observed a model demonstrate irrelevant and relevant actions on a transparent apparatus. Prior to their turn with the apparatus, parents asked their children how they were going to retrieve the object and why they would perform the actions. The majority of participants who included the irrelevant action had stated that they were unsure why the unnecessary action would be performed, that they were not going to perform the unnecessary action, or that the unnecessary action did not retrieve the object. Methodologies that explore verbal responses of children with ASD would provide more nuanced information about the mechanism underlying over-imitation by children with ASD. However, it may also be difficult to access this information given that children with ASD, by definition, have communication problems. This would need to be factored into the research design, such as through verbal ability inclusion criteria for participants.

Future research may look more closely at what actions are considered part of the normative action sequence and whether there may be limits to what children with ASD include in their over-imitation behaviour. One question may be whether children with ASD would imitate elements of the action sequence that are not directly related to operating the apparatus. For example, assume a model makes preliminary actions such as tapping the tool on the table prior to any manipulation of the actual apparatus.

Children with ASD may not imitate the tapping because it is not goal-directed and does not serve a cognitive-apprenticeship function; however, they would, presumably, imitate the goal-directed irrelevant action. TD children, on the other hand, who imitate actions for social and cognitive-apprenticeship functions, would be more likely to include all the actions in the sequence, including the tapping on the table, as part of the normative sequence. Another example might be to have the irrelevant action with the tool be done with a particular style or flourish, such as that done in Hobson and Lee (1999). Again, children with ASD would not be expected to demonstrate the particular style or flourish, since that aspect is not goal-directed, but they would be expected to make the irrelevant action. TD children might be expected to include the flourish/style while making the irrelevant action as part of the normative action sequence. Experiments such as these might distinguish between children with ASD and TD children in over-imitation.

Other directions for future research stem from the link between over-imitation and cultural learning. When considered within a framework of cultural learning, over-imitation appears to have adaptive value. When learning from others involves copying unnecessary actions, it allows an individual to acquire the often opaque nature of cultural information and culturally determined manipulations, actions, behaviours, or operations (Flynn & Smith, 2012). Nielsen, Mushin, Tomasello, and Whiten (2014) posit that over-imitation would have limited value if what was learned was tied to only a specific object or instance in which it was used. They suggest that over-imitation would have more adaptive value if what was learned could be generalized to the wide range of similar objects or circumstances children may later experience in their culture. Through a series of experimental tasks and using both opaque and transparent apparatuses,

Nielsen et al. (2014) found that three- to six-year-old children incorporated irrelevant and relevant actions demonstrated on one apparatus into their manipulation of a novel apparatus. This suggests that information that is inferred from one over-imitation task has the capacity to be generalized to another similar object. Anecdotally, some children with ASD performed an action demonstrated on an earlier apparatus with a subsequent apparatus, providing some preliminary evidence of generalization in this population. However, children with ASD are known to have generalization difficulties (Volkmar et al., 2014). Replication of the Nielsen et al. (2014) paradigm with a sample of children with ASD would tell us whether the adaptive value of such generalization for over-imitation is present in this group.

Conclusion

Research on the over-imitation behaviour of children with ASD is in its infancy. The present study expanded on previous literature by examining social and mistaken causal beliefs explanations of over-imitation and possible correlates of the behaviour in children with ASD and TD children. Participants were exposed to one of two orders of presentation of phases using opaque and transparent apparatuses. Two types of models manipulated the apparatuses. Some models included an irrelevant action when manipulating the apparatus to obtain an object and other models did not make the irrelevant action but were equally successful in obtaining the object. Consistent with previous research, children with ASD included the irrelevant actions with the opaque apparatuses. However, the hypotheses that children with ASD would over-imitate because of a mistaken causal belief and not because of social reasons were not supported.

An element of the procedure that proved to be important was the order of phases that participants received. Participants who received Order One made significantly more irrelevant actions than those who received Order Two. Furthermore, the order variable was a significant predictor of the irrelevant actions. The order effect, greater fidelity of imitation in Order One than Order Two, and the anecdotal evidence of verbal comments provided evidence for the normativity theory as a theoretical explanation for the results. Children with ASD were sensitive to the context of the task presentation and more over-imitation was seen in a conventional context than instrumental context. Thus, children with ASD learned a normative behaviour based on interpreting a context. That the theory would apply to TD children and children with ASD (in the face of no group differences) is an important reminder that the children with ASD do learn from individuals around them even though this does not always look the same as children without this diagnosis. Future research that explores the nuances of over-imitation will provide us with a more extensive understanding of the normativity explanation of over-imitation, and the broader realm of cultural learning, in individuals with a diagnosis of autism spectrum disorder.

Table 1

Study 1; Description of experimental procedure.

Phase	Opacity	Number of apparatuses/trials	Number of demonstrations per apparatus/trial	Models
I	Opaque	2	3	E1: irrelevant model
II	Opaque	2	3	E2: irrelevant model E3: efficient model
III	Transparent	2	3	E1: irrelevant model

Table 2

Description of apparatuses.

Phase	Box	Dimensions (l x w x h)	Tool	Irrelevant action with tool	Related action with tool
I*	Yellow 	8.5 x 5 x 3.5	Piece of dowel, square shape 	Tap the top left corner three times	Push lever to the right
I	Green 	6.5 x 7 x 2.5	Wood hammer 	Swipe on right side of apparatus back and forth two times	Push handle to the left
II	Blue 	8.5 x 3.5 x 2.5	Piece of dowel, round shape 	Swipe on back edge of the lid back and forth one time	Life the bottom of latch
II*	Orange 	6.5 x 4.5 x 3	Short piece of wood, round shape 	Circular swipe on top of lid two times	Lift latch

III	Purple frame 	6 x 4.5 x 3.7	Large size allen key 	Tap the back side two times	Pull the circle piece out
III	Red frame 	6 x 4.5 x 3.7	Medium size ruler 	Swipe on middle of top of the lid back and forth two times	Lift bottom of latch

*These two apparatuses, and the accompanying tool and actions, were also used in Study 2.

Table 3

Study 1; Demographic characteristics of children with ASD and TD children with X^2 comparison results.

	Children with ASD (N=26)		TD Children (N=26)	
Gender	$X^2(1) = 0.10$, $p = .75$			
Male	20		19	
Female	6		7	
Relationship Status	$X^2(5) = 6.35$, $p = .27$			
Married	76.9%		80.8%	
Common-law	7.7%		-	
Single	-		11.5%	
Legally separated	7.7%		3.8%	
Divorced	3.8%		3.8%	
Widowed	3.8%		-	
Income	$X^2(8) = 20.09$, $p = .01$			
Less than $20 000	7.7%		-	
$20-29 000	-		3.8%	
$30-39 000	38.5%		3.8%	
$40-49 000	-		-	
$50-59 000	19.2%[i]		7.7%	
$60-79 000	-		19.2%	
$80-99 000	3.8%		3.8%	
$110-119 000	15.4%		19.2%[i]	
$120 000+	11.5%		34.6%	
Prefer not to say	3.8%		7.7	
Ethnicity	Mothers: $X^2(5) = 5.53$, $p = .35$ Fathers: $X^2(6) = 5.54$, $p = .48$			
	Mothers	Fathers*	Mothers	Fathers**
White/Caucasian	100%	96%	80.8%	85.7%
Chinese	-	-	3.8%	4.7%

Black (e.g., African, Haitian, Jamaican, Somali)	-	-	3.8%	4.7%
Aboriginal/First Nations	-	4%	3.8%	-
Latin-American	-	-	3.8%	-
Korean	-	-	3.8%	4.7%
Highest education level	Mothers: $X^2(9) = 16.33$, $p = .06$ Fathers: $X^2(11) = 17.07$, $p = .11$			
	Mothers	Fathers*	Mothers	Fathers**
Some high school	3.8%	4.3%	-	-
Completed high school	14.5%	26%	-	9.5%
Some community college	3.8%	4.3%	-	4.7%
Some university	3.8%	8.7%	3.8%	4.7%
Completed community college	3.8%	-	11.5%	4.7%
Completed trade, vocational or business college	3.8%	13%[i]	7.7%	4.7%
Undergraduate degree	53.8%[i]	26%	30.8%[i]	9.5%
Master's degree	3.8%	13%	38.5%	33%[i]
Professional degree (e.g., medicine, vet, dentist, etc.)	3.8%	4.3%	3.8%	-
Ph.D.	3.8%	-	3.8%	29%
Employment Status	Mothers: $X^2(7) = 6.97$, $p = .43$		Fathers: $X^2(6) = 6.42$, $p = .38$	
	Mothers	Fathers*	Mothers	Fathers**
Full time	34.6%	65.2%	57.7%	85.7%
Part time	42.3%	26%	30.8%	9.5%
Student	-	-	-	4.8%
Homemaker	7.7%	-	7.7%	-
Retired	-	4.4%	-	-
Government assistance	7.6%	-	-	-
Unemployed	3.8%	-	-	-
Other	3.8%	4.4%	3.8%	-

[i]median level *Information about a father was provided for 88% of children with ASD **Information about a father was provided 81% of TDC

Table 4

Study 1; Descriptive characteristics of children with ASD and TD children and t-test comparison.

	Chronological age in years	Perceptual reasoning from WASI-2	Cognitive ability from the WASI-2	Communication ability from VABS-2	Social motivation from SRS-2[i,]
Children with ASD (N=26)					
Mean (SD)	10.15 (3.25)	108.58 (14.55)	103.23 (12.81)	79.88 (14.23)	71.54 (10.43)
Median	10.5	106.50	99.50	79.00	70.00
Skew	.43	.49	.33	.47	.14
TD children (N=26)					
Mean (SD)	9.35 (2.78)	102.15 (11.12)	102.20 (9.31)	102.92 (12.88)	49.27(7.63)
Median	9.00	104.50	105.00	102.00	48.5
Skew	.69	-.28	-.54	.17	1.17
t-test[ii]	$t(50) = -.96$, $p = .34$	$t(50) = -1.78$, $p = .08$	$t(50) = -.33$, $p = .74$	$t(50) = 6.13$, $p < .001$	$t(50) = -8.79$, $p < .001$

[i]higher scores indicate lower levels of social motivation [ii]t-scores are for mean comparisons between children with ASD and TD children for column variables

Table 5

Study 1; Procedural outline of session upon arrival at the Infant and Child Development Lab.

Parents completed the following tasks:	Children completed the following tasks:
- Consent form - Demographic information form - Questionnaires VABS-II SRS-2	- WASI-II - Break - Over-imitation tasks - Memory tasks

Table 6

Study 1; Demographic characteristics of participants before and after modification to research design, with X^2 comparison.

	All participants		ASD		TD	
	Before (N=17)	After (N=35)	Before (N=8)	After (N=18)	Before (N=9)	After (N=17)
Group	$X^2(1) = 0.08$, p =.747					
ASD	8	18	-	-	-	-
TD	9	17	-	-	-	-
Gender	$X^2(1) = 1.43$, p =.23		$X^2(1) = .02$, p =.88		$X^2(1) = 2.15$, p =.14	
Male	11	28	6	14	5	4
Female	6	7	2	4	4	3
Relationship Status	$X^2(5) = 4.04$, p =.54		$X^2(4) = 2.29$, p =.68		$X^2(3) = 2.44$, p =.49	
Married	82.4%	77%	87.5%	72.2%	77.8%	82.4%
Common-law	-	5.7%	-	11.1%	-	-
Single	11.8%	2.9%	-	-	22.2%	5.9%
Legally separated	5.9%	5.7%	12.5%	5.6%	-	5.9%
Divorced	0%	5.7%	-	5.6%	-	5.9%
Widowed	0%	2.9%	-	5.6%	-	-
Income	$X^2(8) = 10.36$, p =.24		$X^2(6) = 8.63$, p =.20		$X^2(7) = 11.03$, p =.14	
< $20 000	-	5.7%	-	11.1%	-	-
$20-29 000	-	2.9%	-	-	-	5.9%
$30-39 000	35.3%	14.3%	62.5%[i]	27.8%	11.1%	-
$40-49 000	-	-	-	-	-	-
$50-59 000	11.8%[i]	14.3%	25%	16.7%[i]	-	11.8%
$60-79 000	11.8%	8.6%	-	-	22.2%	17.6%
$80-99 000	-	5.7%[i]	-	5.6%	-	5.9%

$110-119 000	23.5%		14.3%		-		22.2%		44.4%[i]		5.9%	
$120 000+	5.9%		31.4%		-		16.7%		11.1%		47.1%[i]	
Prefer not to say	11.8%		2.9%		12.5%		-		11.1%		5.9%	
Ethnicity	M: $X^2(5) = 7.33$, $p = .20$ F: $X^2(6) = 5.63$, $p = .47$				M: *constant* F: $X^2(2) = 3.60$, $p = .17$				M: $X^2(5) = 7.06$, $p = .22$ F: $X^2(5) = 3.91$, $p = .56$			
	M	F*	M	F**	M	F	M	F	M	F	M	F
White/Caucasian	82.4%	86.6%	94%	93%	100%	87.5%	100%	100%	66.7%	86%	88.2%	85.7%
Chinese	5.9%	6.6%	-	-	-	-	-	-	11.1%	14%	-	-
Black (e.g., African, Haitian, Jamaican, Somali)	-	-	2.9%	3.5%	-	-	-	-	-	-	5.9%	7.1%
Aboriginal/First Nations	5.9%	6.6%	-	-	-	12.5%	-	-	11.1%	-	-	-
Latin-American	5.9%	-	-	-	-	-	-	-	11.1%	-	-	-
Korean	-	-	2.9%	3.5%	-	-	-	-	-	-	5.9%	7.1%
Education	M: $X^2(9) = 12.51$, p = .19 F: $X^2(6) = 10.40$, $p = .49$				M: $X^2(9) = 9.01$, $p = .43$ F: $X^2(8) = 10.35$, $p = .24$				M: $X^2(6) = 7.88$, $p = .25$ F: $X^2(9) = 7.49$, $p = .59$			
	M	F*	M	F**	M	F	M	F^	M	F^^	M	F^^^
Some high school	-	-	2.9%	3.5%	-	-	5.6%	6.7%	-	-	-	-
Completed high school	5.9%	13.3%	8.6%	20.1%	12.5%	12.5%	16.7%	33.3%	-	14.3%	-	7.1%
Some community college	-	13.3%	2.9%	-	-	11.5%	5.6%	-	-	14.3%	-	-
Some university	11.8%	6.6%	-	6.9%	12.5%	12.5%	-	6.7%	11.1%	-	-	7.1%
Completed community college	-	-	11.4%	3.5%	-	-	5.6%	-	-	-	17.6%	7.1%

Completed trade, vocational or business college	5.9%	6.6%	5.7%	10.3%	12.5 %	-	-	20%[i]	-	14.3%	11.8%	-
Undergraduate degree	47.1%[i]	33.3%[i]	40%[i]	10.3%[i]	50%[i]	50%[i]	55.6%[i]	13.3%	44.4%[i]	14.3%[i]	23.5%[i]	7.1%
Master's degree	17.6%	13.3%	22.9%	27.6%	-	12.5%	5.6%	13.3%	33.3%	14.3%	41.2%	42.9%[i]
Professional degree (e.g., medicine, vet, dentist, etc.)	-	-	5.7%	3.5%	-	-	5.6%	6.7%	-		5.9%	-
Ph.D.	11.8%	13.3%	-	13.8%	12.5 %	-	-	-	11.1%	28.5%	-	28.6%
Employment Status	M: $X^2(7) = 7.61$, $p = .37$ F: $X^2(6) = 4.75$, $p = .58$				M: $X^2(6) = 6.37$, $p = .38$ F: $X^2(4) = 5.19$, $p = .27$				M: $X^2(3) = 2.44$, $p = .49$ F: $X^2(4) = 1.70$, $p = .79$			
	M	F*	M	F**	M	F	M	F^	M	F^^	M	F^^^
Full time	47%	66.7%	45.7%	79.3%	37.5 %	50.0%	33.3%	73.3%	55.6%	85.7%	58.8%	85.8%
Part time	29.4%	26.7%	40%	13.9%	37.5 %	37.5%	44.3%	20%	22.2%	14.3%	35.3%	7.1%
Student	-	-	-	3.4%	-	-	-	-	-	-	-	7.1%
Homemaker	17.7%	-	2.9%	-	25%	-	-	-	11.1%	-	5.9%	-
Retired	-	6.6%	-	-	-	12.5%	-	-	-	-	-	-
Government assistance	-	-	5.7%	-	-	-	11.2%	-	-	-	-	-
Unemployed	-	-	2.9%	-	-	-	5.6%	-	-	-	-	-
Other	5.9%	-	2.9%	3.4%	-	-	5.6%%	6.7	11.1%	-	-	-

M: Mother F: Father [i]median *Information about a father was provided for 88% of pre-modification participants. **Information about a father was provided for 83% of post-modification participants. [^]Information about a father was provided for 83% of ASD after modification. ^^Information about a father was provided for 78% of TDC before modification. ^^^Information about a father was provided for 82% of TDC before modification.

Table 7

Study 1; Descriptive characteristics before and after for all participants and by group and t test comparisons.

	All Participants		ASD		TDC	
	Before (N=17)	After (N=35)	Before (N=8)	After (N=18)	Before (N=18)	After (N=17)
Age						
Mean (SD)	8.35 (1.99)	10.42 (3.22)	9.00 (2.67)	10.67 (3.41)	7.77 (.97)	10.12 (3.09)
Median	7.00	11.00	7.50	11.00	7.00	10.00
Skew	1.73	.15	1.07	.18	.55	.06
T test	$t(46.79) = -2.85$, $p < .01$		$t(17.12) = -1.34$, $p = .20$		$t(21.07) = -2.94$, $p < .01$	
Perceptual reasoning						
Mean (SD)	101.88 (13.78)	107.05 (12.83)	109.63 (13.77)	108.11 (15.24)	95.00 (9.91)	105.94 (10.01)
Median	98.00	107.00	112.00	106.00	96.00	108.00
Skew	.41	.53	-.19	.37	.37	-.73
T test	$t(29.90) = -1.30$, $p = .20$		$t(14.88) = .25$, $p = .81$		$t(16.56) = -2.70$, $p = .02$	
Cognitive ability						
Mean (SD)	100.71 (9.74)	103.68 (11.71)	103.65 (9.01)	103.06 (14.41)	98.11 (10.14)	104.35 (9.34)
Median	102.00	105.00	106.50	98.50	97.00	106.00
Skew	-.38	.19	-.69	.44	-.15	-.69
T test	$t(37.60) = -.91$, $p = .37$		$t(20.87) = .122$, $p = .90$		$t(13.87) = -1.58$, $p = .11$	
Communication ability						
Mean (SD)	95.35 (13.24)	89.48 (19.47)	86.75 (10.29)	76.83 (14.90)	103.00 (10.86)	102.88 (14.12)
Median	98.00	86.00	85.00	74.50	100.00	104.00
Skew	.13	.18	.01	.98	.36	.14
T test	$t(44.30) = 1.28$, $p = .21$		$t(19.24) = 1.96$, $p = .07$		$t(20.51) = .02$, $p = .98$	
Social motivation[i]						
Mean (SD)	55.47 (12.38)	62.80 (14.91)	65.75 (9.57)	74.11 (9.98)	46.33 (5.17)	50.82 (8.37)
Median	51.00	64.00	69.00	71.00	46.00	52.00
Skew	.40	.29	-.126	.59	.76	.99
T test	$t(37.69) = -1.87$, $p = .07$		$t(19.24) = -2.23$, $p = .06$		$t(23.24) = -1.70$, $p = .11$	

[i]higher scores indicate lower levels of social motivation

Table 8

Study 1; Demographic characteristics of participants in Order One and Order Two.

Demographics	Order One (N=26)		Order Two (N=26)	
Gender	$X^2(1) = .10$, p =.75			
Male	20		19	
Female	6		7	
Relationship Status	$X^2(5) = 4.36$, p =.50			
Married	76.9%		80.8%	
Common-law	3.8%		3.8%	
Single	11.5%		-	
Legally separated	3.8%		7.7%	
Divorced	3.8%		3.8%	
Widowed	-		3.8%	
Income	$X^2(8) = .9.49$, p =.30			
Less than $20 000	3.8%		3.8%	
$20-29 000	-		3.8%	
$30-39 000	26.9%		15.4%	
$40-49 000	-		-	
$50-59 000	11.5%		15.4%	
$60-79 000	7.7%[i]		11.5%[i]	
$80-99 000	-		7.7%	
$110-119 000	23.1%		11.5%	
$120 000+	15.4%		30.8%	
Prefer not to say	11.5%		-	
Ethnicity	Mothers: $X^2(5) = 5.02$, p =.41	Fathers: $X^2(6) = 5.14$, p =.53		
	Mother	Fathers*	Mothers	Fathers*
White/Caucasian	88.5%	91%	92.3%	91%
Chinese	3.8%	4.5%	-	-

Black (e.g., African, Haitian, Jamaican, Somali)	-	-	3.8%	4.5%
Aboriginal/First Nations	3.8%	4.5%	-	-
Latin-American	3.8%	-	-	-
Korean	-	-	3.8%	4.5%
Education	Mothers: $X^2(9) = 12.79$, p =.17 Fathers: $X^2(11) = 14.58$, p =.20			
	Mother	Father	Mother	Father
Some high school	-	4.5%	3.8%	-
Completed high school	7.7%	9.1%	7.7%	27.3%
Some community college	-	9.1%	3.8%	-
Some university	7.7%	9.1%	-	4.5%
Completed community college	-	-	15.4%	4.5%
Completed trade, vocational or business college	3.8%	9.1%	7.7%	9%
Undergraduate degree	53.8%[i]	31.8%[i]	30.8%[i]	4.5%[i]
Master's degree	15.4%	13.6%	26.9%	31.8%
Professional degree (e.g., medicine, vet, dentist, etc.)	3.8%	-	3.8%	4.5%
Ph.D.	7.7%	13.6%	-	13.6%
Employment Status	Mothers: $X^2(7) = 7.48$, p =.387 Fathers: $X^2(6) = 4.17$, p =.65			
	Mother	Fathers	Mother	Father
Full time	50%	72.7%	42.3%	77.2%

Part time	27%	18.3%	46.2%	18.3%
Student	-	-	-	4.5%
Homemaker	11.5%	-	3.8%	-
Retired	-	4.5%	-	-
Government assistance	3.8%	-	3.8%	-
Unemployed	-	-	3.8%	-
Other	7.7%	4.5%	-	-

[i]median *Information about a father was provided for 85% of participants in Order One and Order Two.

Table 9

Study 1; Descriptive characteristics of participants in Order One and Order Two.

	Male	Female	Chronological age in years	Perceptual reasoning from WASI-2	Cognitive ability from the WASI-2	Communication ability from VABS-2	Social motivation from SRS-2[i]
Order One (N=26)	20	6					
Mean (SD)			9.58 (3.07)	106.57 (14.22)	104.16 (10.27)	91.92 (16.66)	58.11 (16.18)
Median			8.5	108.00	107.00	96.00	52.50
Skew			.83	-.02	-.34	.07	.53
Order Two (N=26)	19	7					
Mean (SD)			9.92 (3.02)	104.15 (12.31)	101.31 (11.90)	90.88 (19.37)	62.69 (12.34)
Median			10.00	104.50	99.50	91.00	62.00
Skew			.34	1.01	.55	.03	.59
T test			t(50) = -.41, *p* = .68	t(50) = .66, *p* = .51	t(50) = .91, *p* = .38	t(50) = .21, *p* = .84	t(50) = -1.15, *p* = .26

[i]higher scores indicate lower levels of social motivation

Table 10

Study 1; Correlation between age, maternal education, income, and predictor variables.

	Age^	Maternal education^^	Income^^
Order	.06, p = .68	-.11, p = .43	.07, p = .65
Nonverbal cognition	**.28 p = .05**	.08, p = .58	-.07, p = .63
Cognitive ability	.12 p = .40	.15, p = .28	.00, p = .99
Social motivation	.18, p = .18	**.33, p = .02**	**-.39, p = .01**
Communication	**-.38 p = .01**	.13, p = .37	.16, p = .26

^Pearson's Product-Moment correlations; ^^Spearman's Rho

Table 11

Study 1; Spearman's Rho between age, maternal education, income, and dependent variables.

		Phase I	Phase II – irrelevant model stays	Phase II – efficient model stays	Phase III
Age	Imitation^	**-.37**	**-.45**	-.39	**-.28**
		***p* = .01**	***p* = .02**	*p* = .06	***p* = .05**
	Fidelity^^	**-.33**	**-.44**	-.35	**-.29**
		***p* = .02**	***p* = .02**	*p* = .09	***p* = .04**
	Hands^^^	**.27**	.26	**.45**	**.47**
		***p* = .05**	*p* = .18	***p* = .03**	***p* = <.001**
Maternal education	Imitation^	.16	.20	-.31	.16
		p = .27	*p* = .33	*p* = .15	*p* = .27
	Fidelity^^	.13	.21	-.38	.21
		p = .37	*p* = .29	*p* = .06	*p* = .14
	Hands^^^	-.02	-.20	.35	.09
		p = .88	*p* = .31	*p* = .10	*p* = .54
Income	Imitation^	-.09	-.11	-.12	-.07
		p = .55	*p* = .57	*p* = .61	*p* = .63
	Fidelity^^	-.04	-.08	-.08	-.02
		p = .80	*p* = .70	*p* = .73	*p* = .87
	Hands^^^	.10	.09	.24	.15
		p = .47	*p* = .65	*p* = .27	*p* = .30

^imitation of irrelevant actions; ^^fidelity of irrelevant actions ^^^use of hands for related action

Table 12

Study 1; Mean percent of trials (standard deviation) where participants made the causally irrelevant action in Phase I, Phase II, and Phase III.

	Phase I	Phase II – efficient model stays	Phase II - irrelevant model stays	Phase III
Order One				
ASD	84.62 (31.52)	83.33 (40.82)	42.85 (44.99)	76.92 (43.85)
TD	84.62 (31.52)	33.33 (40.82)	50.00 (50.00)	84.62 (31.52)
Order Two				
ASD	38.46 (41.60)	50.00 (54.77)	28.57 (39.34)	34.62 (42.74)
TD	38.46 (41.60)	25.00 (27.39)	35.71 (47.56)	38.46 (46.34)

Table 13

Study 1; Mean percentage of trials imitation of irrelevant action by temporal ordering of phases and order (standard error).

	Time/Phase	Irrelevant action
Order One	1/Phase I	84.33 (6.68)
	2/Phase II	51.18 (7.93)
	3/Phase III	80.04 (8.01)
Order Two	1/Phase II	35.85 (6.68)
	2/Phase I	39.82 (7.93)
	3/Phase III	36.28 (8.01)

Table 14

Study 1; Phase I - partial correlations controlling for age and order for imitation of irrelevant actions variable and fidelity variable (in italics).

	Nonverbal cognition	Social motivation[i]	Communication
Irrelevant action	-.13	.09	**-.36***
Fidelity	*-.11*	*.12*	***-.28****
Nonverbal cognition		**.32***	-.00
Social motivation			**-.64****

Note. *p<.05 **p<.01 [i]higher scores indicate lower levels of social motivation

Table 15

Study 1; Regression analysis for Phase I imitation of causally irrelevant actions variable.

Variable	*B*	*SE B*	β	sr	sr^2	R^2	F for R^2	△R2
Step 1						.14	8.04**	.14
Age	-5.26*	1.86	-.37	-.37	.14			
Step 2						.50	7.45**	.36
Age	-6.29*	1.73	-.46	-.38	0.14			
Group	-14.32	15.43	-.17	-.01	.00			
Order	-45.29**	9.44	-.54	-.51	.26			
Communication	-.94*	.39	-.39	-.25	.06			
Nonverbal cognition	-.21	.39	-.01	-.06	.00			
Social motivation	.04	.57	-.01	-.01	.00			

Note: *$p < .05$, **$p < .001$

Table 16

Study 1; Regression analysis with Phase I fidelity of irrelevant actions variable.

Variable	*B*	*SE B*	β	sr	sr^2	R^2	F for R^2	△R2
Step 1						.11	6.17*	.11
Age	-4.35*	1.75	-.33	-.33	.11			
Step 2						.46	6.42**	.35
Age	-5.14*	1.66	-.39	.34	.12			
Group	-17.51	14.83	-.22	-.13	.02			
Order	-43.67**	9.07	-.56	-.53	.28			
Communication	-.73^	.34	-.33	-.21	.04			
Nonverbal cognition	-.21	.38	.07	-.06	.00			
Social motivation	.28	.54	.10	.06	.00			

Note: * p < .05, ***p* < .001, ^*p* = .06

Table 17

Study 1; Phase II, irrelevant model stays condition - partial correlations controlling for age and order for imitation of causally irrelevant actions variable and fidelity variable (in italics).

	Nonverbal cognition	Social motivation[i]	Communication
Irrelevant action	-.23	-.06	-.01
Fidelity	-*.28*	-*.05*	-*.00*
Nonverbal cognition		.21	.07
Social motivation			**-.68***

Note. ***p*<.01 [i]higher scores indicate lower levels of social motivation

Table 18

Study 1; Regression analysis with Phase II irrelevant model stays condition imitation of irrelevant actions variable.

Variable	*B*	*SE B*	β	sr	sr^2	R^2	F for R^2	△R2
Step 1						.20	6.62*	.20
Age	-6.36*	2.47	-.34	-.45	.20			
Step 2						.28	1.34	.07
Age	-4.86	3.22	-.34	-.28	.08			
Group	2.57	29.28	.03	.02	.00			
Order	-22.54	19.47	-.26	-.22	.05			
Communication	.00	.69	.00	.00	.00			
Nonverbal cognition	-.85	.87	-.24	-.18	.03			
Social motivation	-.10	.92	-.04	-.02	.00			

Note: * $p < .05$

Table 19

Study 1; Regression analysis with Phase II irrelevant model stays condition fidelity of irrelevant actions variable.

Variable	*B*	*SE B*	β	sr	sr^2	R^2	F for R^2	△R2
Step 1						.20	6.30*	.20
Age	-5.93*	2.36	-.44	-.44	.19			
Step 2						.30	1.50	.11
Age	-4.21	3.01	-.31	-.26	.07			
Group	-.34	27.39	-.04	-.02	.00			
Order	-27.60	18.22	-.34	-.28	.08			
Communication	.05	.65	.03	.02	.00			
Nonverbal cognition	-1.03	.82	-.31	-.23	.05			
Social motivation	.15	.86	.06	.03	.00			

Note: $*p < .05$

Table 20

Study 2: Frequency of trials where participants made the causally irrelevant action.

Condition	Mean (standard deviation)
Efficient model stays	1.25 (.97)
Irrelevant model stays	1.08 (.99)
Both irrelevant models	1.75 (.62)

One-way ANOVA $F(2, 35) = 1.88$, $p = .17$

Table 21

Study 2; Fidelity of imitation of irrelevant action.

Condition	Mean (standard deviation)
Efficient model stays	2.83 (2.00)
Irrelevant model stays*	2.42 (2.27)
Both irrelevant models*	4.33 (1.44)

One-way ANOVA $F(2, 35) = 3.21$, $p = .05$; *$p = .06$

Figure 1

Study 1; Percentage of irrelevant actions by age, Phase, and group

.

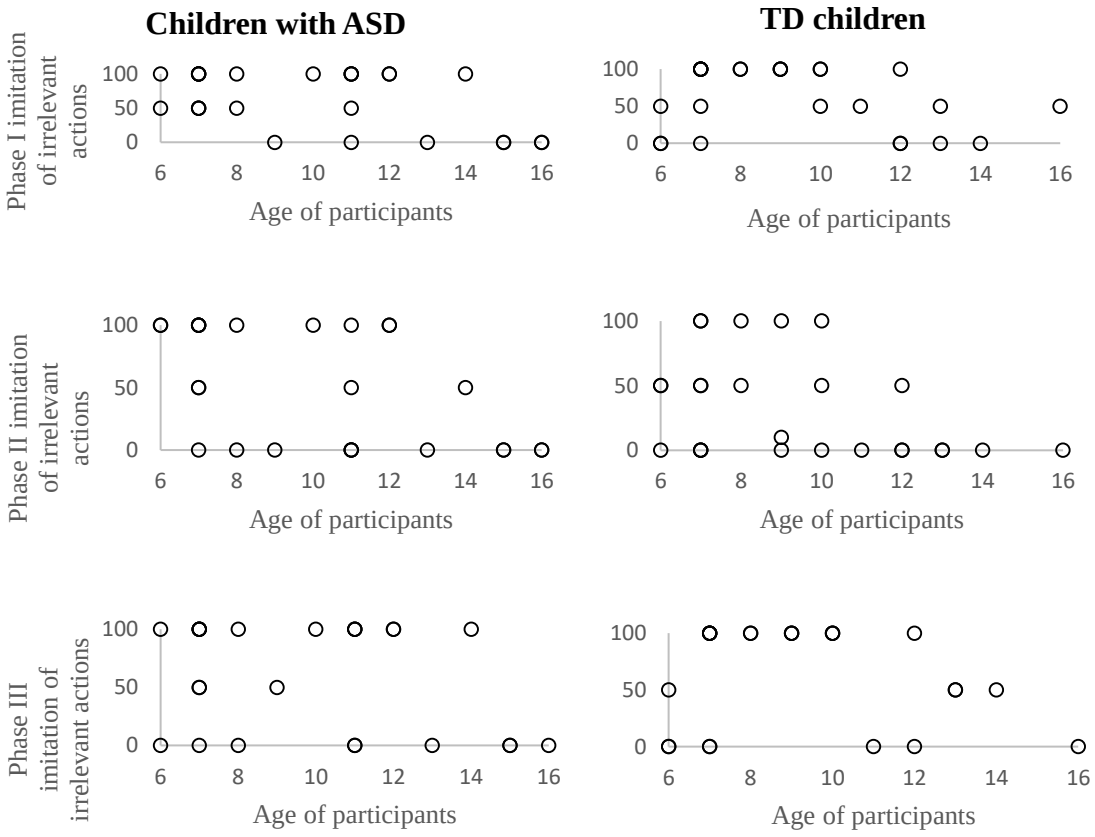


Figure 2

Study 1: Visual representation of responses in Order One, separated by group and Phase II condition

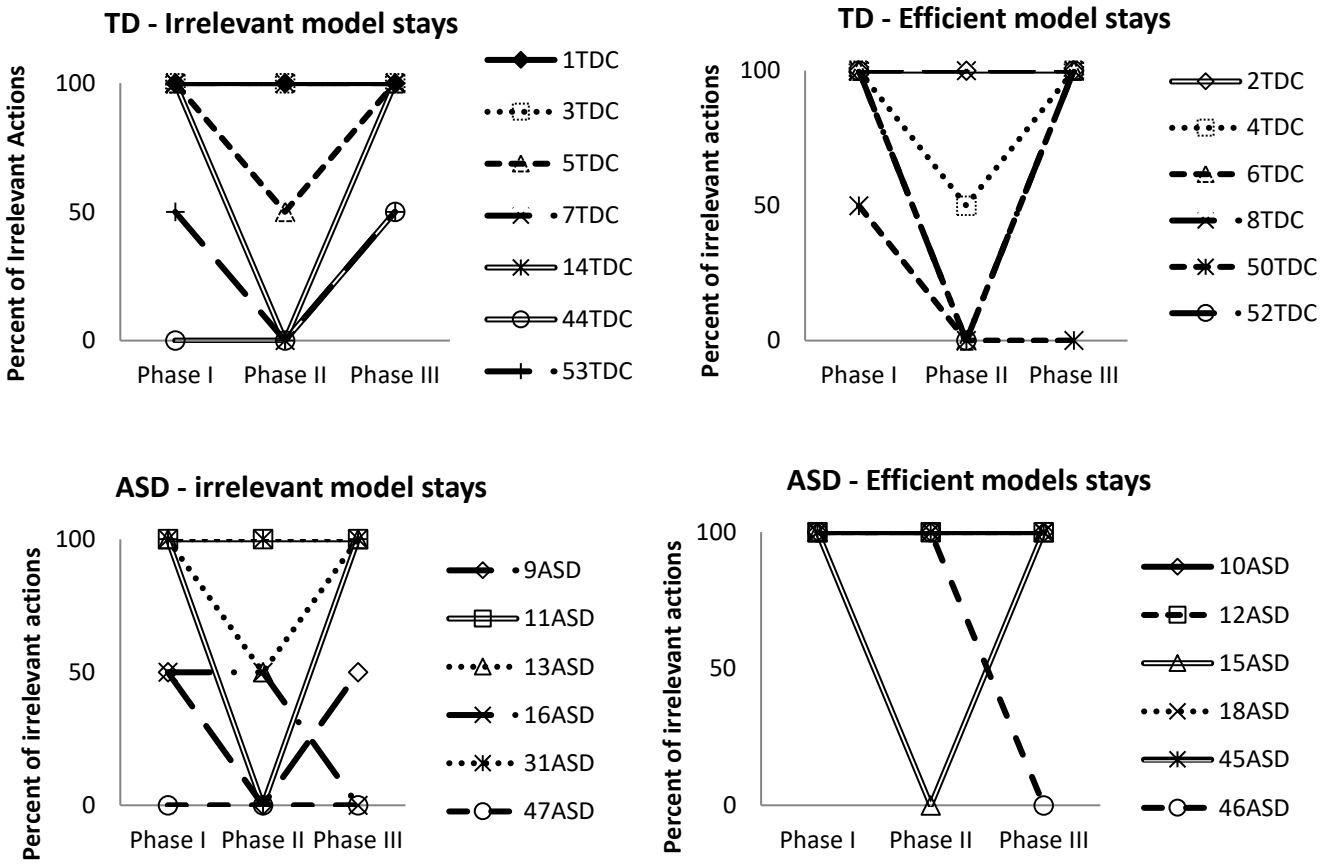
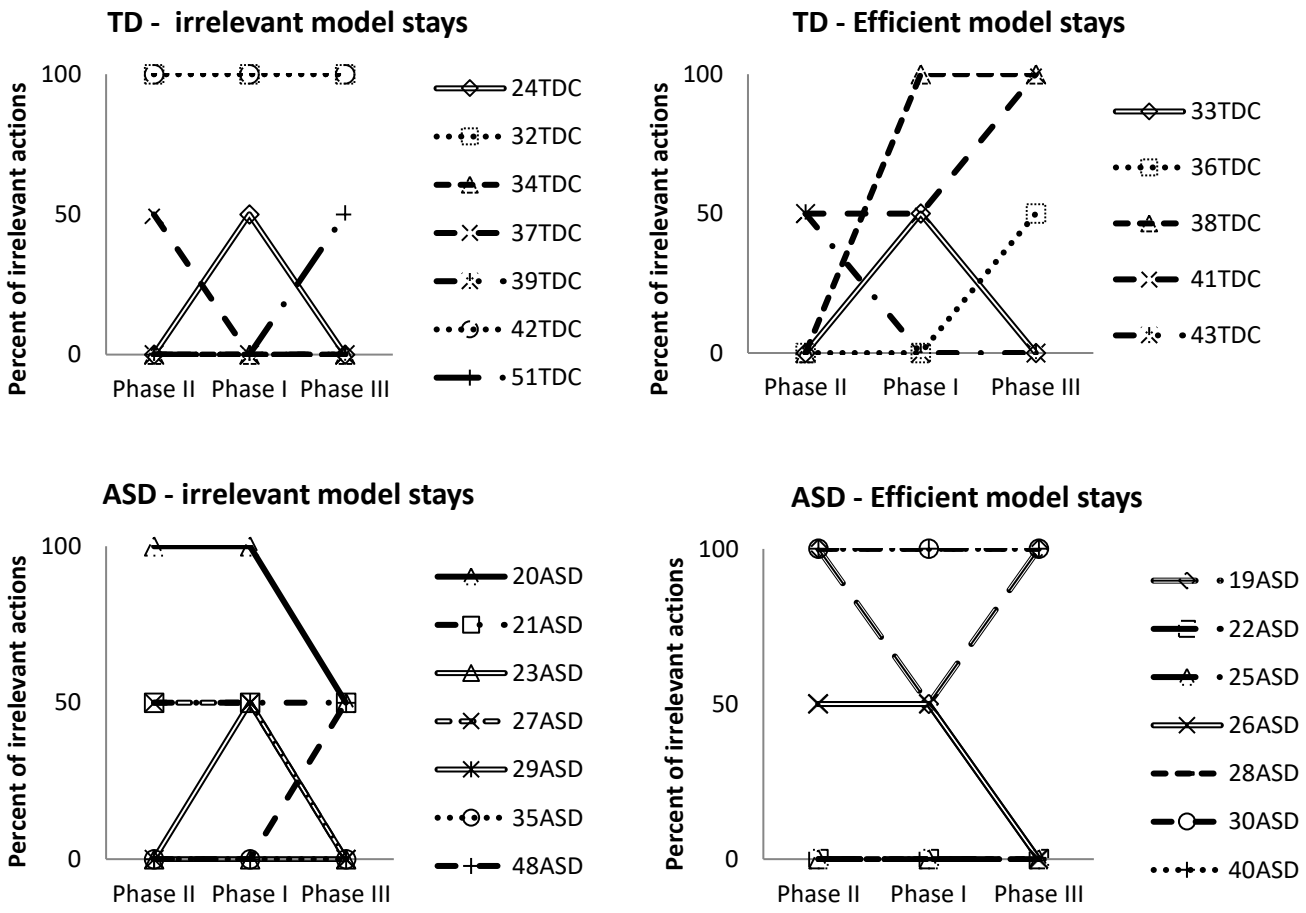


Figure 3

Study 1: Visual representation of responses in Order Two, separated by group and Phase II condition



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Appendix A

Study 1: Examples of Recruitment of Children with Autism Spectrum Disorder using Electronic Sources

University of New Brunswick E-daily news

Looking for something fun to do with your child?!

Help us research how children decide which behaviours to copy when watching someone else use a new toy.

Researchers at the UNB Psychology Department are looking for children with an Autism Spectrum Disorder between 6 and 18 years of age to participate.

Participants will receive $20.00 cash and a Child Scientist Certificate.

For more information please contact Jackie at actions.unb@gmail.com or 506-458-7590.

This project is on file with the University of New Brunswick Fredericton REB File ########

Social Media (e.g., Facebook pages)

6-18 year old's needed for research project! $20.00 cash included!

My name is Jackie Normand and I'm studying how children with an Autism Spectrum Disorder decide what behaviours to copy when watching someone else use a new toy. The study takes place at UNB's Psychology Department. I ask children to do different activities that cover areas like thinking and problem-solving, memory, and copying actions with objects. I also ask parents to fill out a few questionnaires. Participants will receive $20.00 cash for participation.

Please contact Jackie at actions.unb@gmail.com or 506-458-7590 if you would like to participate or if you have any questions. I am a Clinical Psychology doctoral student at UNB. My supervisor is Dr. Barbara D'Entremont, a licensed psychologist in New Brunswick and a professor at UNB.

This project is on file with the UNB Fredericton REB File # #######

Kijiji advertisement – Format A

Looking for something fun to do with your child?!

Help us research how children decide which behaviours to copy when watching someone else use a new toy.

Researchers at the University of New Brunswick are looking for children diagnosed with an Autism Spectrum Disorder between 6 and 18 years of age to participate.

Participants will receive $20.00 cash and a Child Scientist Certificate.

For more information please contact Jackie at actions.unb@gmail.com or 506-458-7590

This project is on file with the University of New Brunswick Fredericton REB ######

Kijiji Advertisement – Format B

Participate in a study at UNB for $20.00 cash!

Researchers at the University of New Brunswick are looking for children between 6 and 18 years of age with an Autism Spectrum Disorder to participate in research looking at how children decide which behaviours to copy when watching someone else use a new toy.

Participants will receive $20.00 cash and a Child Scientist Certificate.

For more information please contact Jackie at actions.unb@gmail.com or 506-458-7590

This project is on file with the University of New Brunswick Fredericton REB #######

Appendix B

Study 1: Examples of Recruitment of Typically Developing Children using Electronic Sources

University of New Brunswick E-daily news
Looking for something fun to do with your child?! Help us research how children decide which behaviours to copy when watching someone else use a new toy.

Researchers at the UNB Psychology Department are looking for children between (we will insert age to match the sample with autism once the sample with autism is recruited) to participate.

Participants will receive $20.00 cash and a Child Scientist Certificate.

For more information please contact Jackie at actions.unb@gmail.com or 506-458-7590.

This project is on file with the University of New Brunswick Fredericton REB File ########

Kijiji Advertisement – Format A
Looking for something fun to do with your child?!

Help us research how children decide which behaviours to copy when watching someone else use a new toy.

Researchers at the University of New Brunswick are looking for children between (we will insert age to match the sample with autism once the sample with autism is recruited) to participate.

Participants will receive $20.00 cash and a Child Scientist Certificate.

For more information please contact Jackie at actions.unb@gmail.com or 506-458-7590.

This project is on file with the University of New Brunswick Fredericton REB ######

Kijiji Advertisement – Format B
Participate in a study at UNB for $20.00 cash!

Researchers at the University of New Brunswick are looking for children between (we will insert age to match the sample with autism once the sample with autism is recruited) to participate in research looking at how children decide which behaviours to copy when watching someone else use a new toy.

Participants will receive $20.00 cash and Child Scientist Certificate.

For more information please contact Jackie at actions.unb@gmail.com or 506-458-7590

This project is on file with the University of New Brunswick Fredericton REB ########

Appendix C

Study 1: Recruitment Poster for Children with an Autism Spectrum Disorder

HELP US RESEARCH IMITATION IN CHILDREN WITH AN AUTISM SPECTRUM DISORDER!

We are looking for children diagnosed with an Autism Spectrum Disorder between 6 and 18 years of age to participate

Please contact Jackie for more information

UNB

Infant and Child Development Studies
Psychology Department
University of New Brunswick

Email: actions.unb@gmail.com
Tel: 506-458-7590

$20.00 CASH AND A CHILD SCIENTIST CERTIFICATE INCLUDED

This project is on file with the University of New Brunswick Fredericton REB # ######

★ ★

Jackie actions.unb@gmail.com 506-458-7590

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Jackie actions.unb@gmail.com 506-458-7590

Appendix D

Study 1: Recruitment Poster for Typically Developing Children

HELP US RESEARCH IMITATION AND OBJECT USE!

We are looking for children between (we will insert age to match the sample with autism once the sample with autism is recruited) to participate

Please contact Jackie for more information

UNB

Infant and Child Development Studies
Psychology Department
University of New Brunswick

Email: actions.unb@gmail.com
Tel: 506-458-7590

$20.00 CASH AND A CHILD SCIENTIST CERTIFICATE INCLUDED

This project is on file with the University of New Brunswick Fredericton REB ######

★ ★

Jackie actions.unb@gmail.com 506-458-7590

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Appendix E

Study 1: Letter to local psychologist

University of New Brunswick

PO Box 4400
Fredericton, NB
Canada
E3B 6E4

Tel 506 458-7692
Fax 506 447-3063
bdentrem@unb.ca
people.unb.ca/~bdentrem

Department of Psychology

Dr. Barbara D'Entremont
Professor

Dear LOCAL PSYCHOLOGIST,

My name is Jackie Normand and I'm a doctoral student in the clinical psychology program at UNB. I'm currently conducting a research project at UNB with my supervisor Dr. Barbara D'Entremont. She is a licensed psychologist in New Brunswick and a professor at the University of New Brunswick. I'm studying how children decide which behaviours to imitate when they copy the behaviours of another person. I'm specifically interested in the imitation of actions directed towards a novel apparatus.

My sample includes children with a diagnosis of Autistic Disorder, Asperger's, and PDD-NOS who are between the ages of 6 and 18 years. There are no cognitive or language restrictions. Would it be possible for you to provide information about my study to previous/current clients who meet the criteria? I would provide you with the letters to mail out describing the study. I could also provide you with a pdf version of the letter should you like to email it to clients who meet the criteria. Finally, would it be possible to put a poster or pamphlets out at your facility advertising my project?

I will follow-up with you to determine if these options are possible.

Please let me know if you have any questions or would like more information. I have included a copy of the letter that would be sent to clients who meet criteria for the study.

Please feel free to contact me at actions.unb@gmail.com or 506-458-7590.

Thanks,

Jackie Normand, B.A. (Hons)

Ph.D candidate, Clinical Psychology

University of New Brunswick,

Fredericton, NB

Appendix F

Study 1: Letter to parent sent from local psychologist

University of New Brunswick

PO Box 4400
Fredericton, NB
Canada
E3B 6E4

Tel 506 458-7692
Fax 506 447-3063
bdentrem@unb.ca
people.unb.ca/~bdentrem

Department of Psychology

Dr. Barbara D'Entremont
Professor

Dear Parent/Guardian,

LOCAL PSYCHOLOGIST sent you this letter on my behalf. My name is Dr. Barbara D'Entremont. I am a professor at the University of New Brunswick. I am also a licensed clinical psychologist in New Brunswick. My Doctoral student, Jackie Normand, and I are studying how children with an autism spectrum disorder learn from the people around them and the role of imitation in this learning. We are looking for children with a diagnosis of Autistic Disorder, Asperger's, and PDD-NOS who are between the ages of 6 and 18 years to participate.

The part of learning we are interested in is how children decide what behaviours of someone else's to copy when learning how to use a new object. Children use information in the surrounding environment when learning how to use a new object. For example, children use information about what the object looks like and what it does. Children also look at the way in which other people use the object. They observe what other people do to the object to make it work. Using all this information, children then decide how they will use the object.

Research has investigated how children decide which behaviours to copy by having children copy an adult who opens a box using necessary and unnecessary actions to get a toy that is inside. Children are then given the box to try to get the toy. Research has found that children with and without autism will include the unnecessary action when they open the box to get the toy. This seems odd given that the unnecessary action is not required to open the box.

Understanding why children copy an action that is not necessary is important for understanding how cultural information is learned. Cultural information is sometimes passed from one generation to the next through stories and direct teaching and sometimes it is picked up through observation and imitation of the people around us who make up our culture. Imitation, in fact, is very important for learning about culture because often the distinctive features of a culture are often not explicitly talked about. Instead, they are learned through observation and imitation.

Researchers suggest that the reason children may include this unnecessary action may be because they want to be social with the adult or because they don't understand that the action is not necessary. I am testing these two theories with children with autism.

I ask children to do different activities with an examiner. The activities cover areas like thinking and problem solving, memory, and copying actions to get a toy out of a box. I also ask parents to fill out a few questionnaires.

The study takes place at UNB's Psychology Department. It takes one 60-90 minute visit. I try to make the visits as fun as possible. I will take breaks as needed. Visits can be on week-days, evenings, or weekends. Participants receive $20.00 cash. Participation is completely voluntary. You are free to withdraw at any time for any reason.

LOCAL PSYCHOLOGIST sent you this letter because your child has a diagnosis of an autism spectrum disorder. LOCAL PSYCHOLOGIST has not shared, and will not share, any information with us. Your participation in this project is voluntary and confidential. LOCAL PSYCHOLOGIST will not be aware of who participates or does not participate in this project and your participation will not influence your relationship with LOCAL PSYCHOLOGIST or the services you receive.

If you would like more information or to participate please contact us directly: Jackie at actions.unb@gmail.com or 506-458-7590.

Please do not hesitate to contact me at the above email or phone number with any questions.

I hope you will choose to participate in this project.

Sincerely,

Barbara D'Entremont, Ph.D., L.Psyc.
Professor and Director of Clinical Training

Jackie Normand, B.A. (Hons)
PhD Student, Clinical Psychology

This project is on file with the University of New Brunswick Fredericton REB ##

Appendix G

Study 1 and 2: Family Information Form

In order to understand how well the findings from this research project represent the "general public", it is necessary to report summary information about the participants. Your responses to the following questions will remain confidential and will not be associated with your name or your child's name in any way. To facilitate in this process, please do not put your name on this form.

1. Current relationship status (please select one):

Married	Common Law	Single	Legally Separated	Divorced	Widowed
○	○	○	○	○	○

2. Relationship to child:	**You**	**Partner/Other Caregiver**
Biological mother		
Biological father		
Adoptive mother		
Adoptive father		
Foster mother		
Foster father		
Other (please specify) _____ _____		

7. Ethnic or cultural heritage	**You**	**Partner/Other Caregiver**
White/Caucasian		
Chinese		
South Asian (e.g., East Indian, Pakistani, Punjabi, Sri Lankan)		
Black (e.g., African, Haitian, Jamaican, Somali)		
Native/Aboriginal People (North American Indian, Métis or Inuit/Eskimo)		

Arab/West Asian (e.g., Armenian, Egyptian, Iranian, Lebanese, Moroccan)		
Filipino		
South East Asian (e.g., Cambodian, Indonesian, Laotian, Vietnamese)		
Latin-American		
Japanese		
Korean		
Other (please specify) _____		

5. Language used most often to speak to child at home:

_____

6. Any other language(s) spoken regularly at home:

_____

9. Highest level of education	**You**	**Partner/Other Caregiver**
Grade 8 or less		
Some high school		
Completed high school		
Some trade, technical or vocational school or business college		
Some community college or CEGEP		
Some university		
Completed Community College/University		
Completed Trade, Technical or Vocational School or Business College		
Bachelor / Undergraduate degree (e.g., BA, BSc, BEd)		
Master's degree (e.g., MA, MSc, MEd)		
Professional degree in Medicine (MD), Dentistry (DDS, DMD), Veterinary Medicine (DVM), Optometry (OD), or Law (LLB, JD)		
Doctorate (e.g., PhD, DSc, EdD)		
Other Please specify: _____		

10. Current occupational status	**You**	**Partner/Other Caregiver**
Employed Full Time		
Employed Part Time		
Unemployed		
Retired		
Student		
Homemaker		
Company paid sick leave		
Government disability		
Social assistance		
Other Please specify: _____		

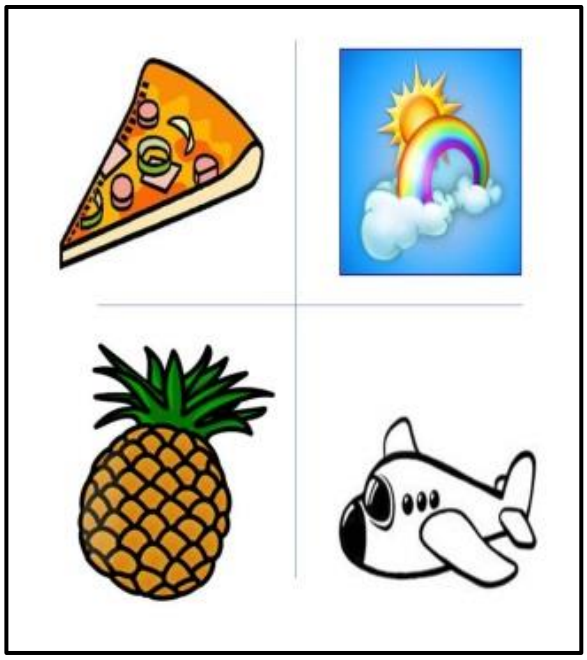
11. Household income.

Less than $20,000	
$20,000 - $29,999	
$30,000 - $39,999	
$40,000 - $49,999	
$50,000 - $59,999	
$60,000 - $79,999	
$80,000 – $99,999	
$100,000 – $119,999	
$120,000 or more	
Prefer not to say	

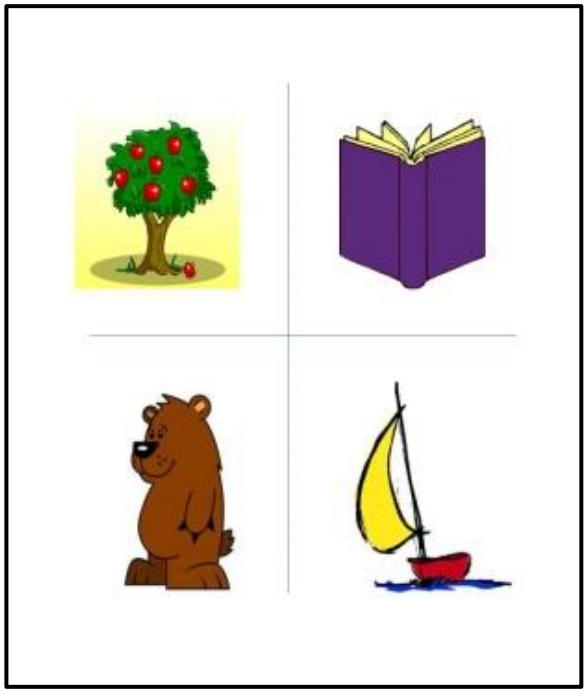
Appendix H

Study 1: Cards for Nonverbal memory Task

Card #1



Card #2



Appendix I

Study 1: Consent Form – Page 1

Project Title: Over-imitation in children with and without a diagnosis of Autism Spectrum Disorder

Principal Investigator: Jackie Normand (PhD Student)

Supervisor: Dr. Barbara D'Entremont, Ph.D., L. Psyc.

Address: Psychology Department, University of New Brunswick **Tel:** 458-7692

Dear Parent or Guardian,

We are studying how children with and without an autism spectrum disorder decide which behaviours to copy when copying someone else's behavior. We think children's thinking and problem solving skills, social motivation, and communication may be important factors in this behavior. We also want to know if memory and small muscle use are important for this behavior.

Your child will take part in the following activities:

- **Wechsler Abbreviated Scale of Intelligence Second Edition (WASI-II):** To evaluate children's thinking and problem solving skills.
- **A brief verbal memory test:** Your child will be presented with sets of numbers that he or she will be asked to repeat back to the examiner.
- **A brief nonverbal memory test:** Using a card with four pictures on it, the examiner will point to two- and three- picture sequences. Your child will be asked to point to pictures in the same order as the examiner did.
- **Break:** A 5-10 minutes break will be taken after the completion of the two memory tasks. Children will have access to a number of age-appropriate toys and/or materials.
- **Imitation tasks:** These tasks involve objects with a toy inside. Your child will observe examiners make necessary and unnecessary actions to retrieve a toy from inside boxes. Your child will then be given the boxes to get the toy out of the boxes.

We will ask you to complete the following questionnaires:

- **Social Responsiveness Scale – Second Edition**: We will ask you to fill a questionnaire about your child's social functioning. This questionnaire will also be used to confirm your child's diagnosis of Autism Spectrum Disorder.

- **Vineland Adaptive Behaviour Scale – Second Edition:** We will ask you to fill out a questionnaire about your child's communication skills, daily living skills, motor skills, and socialization skills.
- **Demographic Questionnaire:** We will ask you to fill out a demographics form.

The activities take place in one 60 to 90 minute session. Additional breaks will be taken as needed.

The activities will be videotaped and the examiner will record your child's responses. The information collected is confidential. A password protected computer in a locked laboratory will be used to store the videos. This computer is only used for research videos and can only be accessed by the researcher and research assistants. Each child will be given a participant identification number and all data will be labeled only with this number. Participation is voluntary- you or your child may choose to withdraw from the study for any reason at any time. You and your child may also refuse to answer any questions.

Your child will receive $20.00 cash and a Child-Scientist certificate after the visit.

The cash and Child-Scientist certificate will be received no matter how your child does with the activities and regardless of whether you or your child choose to withdraw from the study at any time.

A summary of the group results can also be provided. Please fill out the information on the next page if you would like a summary of the group results sent to you.

This form has two pages. The first double-sided (information) page is for you to keep. The second (signature) page will be kept separate from any data collected by the principal investigator. If you have any concerns regarding this research that you do not wish to share with the principal investigator, you may contact Dr. Sandra Byers, Chair of the Psychology Department at (506) 458-7803, the Chair of the Psychology Ethics Review Committee, Dr. David Clark at (506) 452-6225, or the chair of the UNB Research Ethics Board, Dr. Steven Turner (506) 453-5189.

Thank-you for your interest in our research program.

Sincerely,

Jackie Normand	Barbara D'Entremont, Ph.D., L. Psyc.
Principal Investigator (PhD Student)	Professor and Supervisor

This project has been reviewed by the UNB Research Ethics Board and is on file as #####

Consent Form – Page 2

Project Title: Over-imitation in children with and without a diagnosis of Autism Spectrum Disorder
Principal Investigator: Jackie Normand (PhD Student)
Supervisor: Dr. Barbara D'Entremont, Ph.D., L. Psyc.
Address: Psychology Department, University of New Brunswick **Tel:** 458-7692

I have read the above information and agree for my child to take part in this study
Yes ❑ No ❑

_____ _____

Name of Child Date of Birth

_____ _____

Signature of parent Printed name of parent

_____ _____

Signature of researcher Date

I would like a summary of the group results of the research project Yes ❑ No ❑

Preferred method for receiving results

Home address ❑ Email address ❑*Note that email is not secure

Home address: _____

_____

_____

_____

Email address: _____

CONTACT INFORMATION

Phone number:_____

I would like to be contacted about future research Yes ❑ No ❑

I would like to be contacted about my other children participating in future research
Yes ❑ No ❑

Name: _____ Date of Birth:_____

Name:_____ Date of Birth: _____

Video Consent Form

Date: _____

Section A

I have been given reasonable opportunity to view the videotape made of my child
Signature: _____

I agree to allow Dr. Barbara D'Entremont to store the videotape of my child for future research purposes. I understand that such research will only be undertaken with the approval of an ethics committee. A password protected computer in a locked laboratory will be used to store the videos. This computer is only used for research videos and can only be accessed by the researcher and research assistants. I understand that my or my Child's name will not be associated with the videotape.
Signature: _____

I agree to allow Dr. Barbara D'Entremont to use the videotape of my child, and/or pictures made from the videotape of my child, for the following purpose

	Please Check
1) Publication in a journal	____
2) Demonstration at a conference	____
3) Demonstration to students	____

I understand that neither my name nor my Child's name will be associated with the work.
Signature: _____

Section B

I prefer not to have the videotape of my child shown in classes or at conferences or reproduced in any form.
Signature: _____

Section C

I prefer to have the videotape of my child destroyed 7 years post-publication.
Signature: _____

Appendix J

Study 1: Debriefing Letter

Over-imitation in children with and without Autism Spectrum Disorder

PARTICIPANT FEEDBACK FORM

WHAT WE LOOKED AT

We are interested in how children learn how to use a new object after watching another person use the object. Sometimes children use information about what the object is made of or how it works to decide how to use the object and sometimes children watch how other people use the object and then do the same thing as other people do.

Research has found that children will imitate actions they see an adult make on an object to remove a toy that is in the object even when the actions are not actually necessary for getting the toy. The imitation of actions that are not necessary for removing the toy from within the object is called over-imitation. Children imitate actions that are not necessary for getting the toy when they could have just removed the toy an easier way without the unnecessary actions. Children with and without an Autism Spectrum Disorder (ASD) show this behaviour.

Two theories have been suggested to explain this behaviour.

The social affiliation theory says that children imitate actions that are not necessary because they want to be like the model and to socialize with the model.

The non-social theories say that children imitate the unnecessary actions because they don't understand that the action is not necessary to get the toy or because they think the action has a purpose but they aren't sure what it is.

Research suggests that children without an ASD over-imitate for social reasons. It is unclear whether the same is true for children with an ASD so we decided to investigate this.

We also wanted to know if things like the way a child thinks and solves problems, social motivation, memory, and use of small muscles influenced how children copied actions made on an object.

WHAT WE DID

Thinking and problem solving skills: The way children interact with new objects may have to do with how they think. To look at this, your child completed a cognitive test with the examiner.

Memory: In order for children to use a new object the way they saw someone else use it, they have to remember what the person did. To see if memory was involved in the actions your child chose to copy, your child participated in two brief memory tasks. In the first task, your child was asked to repeat sequences of numbers said by the examiner. In the second task your child was asked to point to the same sequence of pictures as the examiner.

Social motivation and communication: To look at these, we asked you to fill out questionnaires.

Small muscles: To look at this, parents reported on their child's small muscle use (e.g. printing, typing).

PLEASE TURN OVER

PARTICIPANT FEEDBACK FORM

WHAT WE DID, CONTINUED

Imitation: Your child observed examiners make unnecessary and necessary actions to retrieve a toy from inside an object. Some objects were opaque and some were transparent. After each demonstration, your child was given the object to get the toy out.

During one phase, your child also observed two examiners get a toy from inside the same object. One examiner always made unnecessary and necessary actions on the object to get the toy and the other examiner always made just the necessary actions on the object to get the toy. One examiner then left the room and your child was given the object to get the toy out.

When the research is complete, these imitation tasks will tell us what information children used to get the toy (e.g., information about what the object was made of and/or the actions made by the examiner).

This research will also tell us whether a social theory or a non-social theory explains what children do. If a social theory is supported, children will only copy unnecessary actions when the person who made unnecessary actions on the object stays in the room. On the other hand, if a non-social theory is supported, children should stop copying unnecessary actions when they can clearly see inside the transparent object that the action is not necessary.

WHY WE DID IT

This project will help us understand what information children with and without an ASD use when deciding which of a person's behaviours to copy. We hope this will help people who provide therapy for children with an ASD and help expand our understanding of the disorder.

If you have any questions about this research project you may contact us at actions.unb@gmail.com (Jackie Normand) or 506-458-7692 (Dr. Barbara D'Entremont).

If you have any questions or concerns about your rights or treatment as a research participant, you may contact the Chair of the Psychology Research Ethics Committee at UNB, Dr. David Clark at (506) 452-6225 (clark@unb.ca) or the Chair of the Department of Psychology, Dr. Sandra Byers at (506) 458-7697 (byers@unb.ca).

THANK YOU FOR PARTICIPATING IN THIS RESEARCH PROJECT!

This project is on file with the University of New Brunswick Fredericton REB #######

Appendix K

Study 2: Letter to parent and consent form to participate at childcare facility

University of New Brunswick
PO Box 4400
Fredericton, NB
Canada
E3B 6E4
Tel 506 458-7692
Fax 506 447-3063
bdentrem@unb.ca
people.unb.ca/~bdentrem
Department of Psychology
Dr. Barbara D'Entremont
Professor

Dear Parent/Guardian,

DAYCARE sent you this letter on my behalf. My name is Dr. Barbara D'Entremont. I am a professor at the University of New Brunswick. I am also a licensed clinical psychologist in New Brunswick. My Doctoral student, Jackie Normand, and I are studying how preschool-age children learn by watching others. We are looking for children between the ages of 4 and 5 years to participate. Participants will receive a small toy and stickers at the end of the session. Participants will also be entered into a draw for a 1/5 chance to win a $20.00 Chapters gift card. The draw will take place at the end of the study.

The part of learning we are interested in is how children decide what behaviours of someone else's to copy when learning how to use a new object. Children use information in the surrounding environment when learning how to use a new object. For example, children use information about what the object looks like and what it does. Children also look at the way in which other people use the object. They observe what other people do to the object to make it work. Using all this information, children then decide how they will use the object.

Research has investigated how children decide which behaviours to copy by having children observe an adult who opens a box using necessary and unnecessary actions to get an object that is inside. Children are then given the box to get the object. Research has found that children will include the unnecessary action when they open the box to get the toy. This seems odd given that the unnecessary action is not required to open the box.

Understanding why children copy an action that is not necessary is important for understanding how cultural information is learned. Cultural information is sometimes passed from one generation to the next through stories and direct teaching and sometimes it is picked up through observation and imitation of the people around us who make up our culture. Imitation, in fact, is very important for learning about culture because often the distinctive features of a culture are not explicitly talked about. Instead, they are learned through observation and imitation.

Researchers suggest that the reason children may include this unnecessary action may be because they want to be social with the adult or because they don't understand that the action is not necessary. I am testing these two theories.

Specifically, your child will take part in an imitation task with the examiner. The task involves boxes with a toy or some small object inside. Your child will observe examiners make necessary and unnecessary actions to retrieve a toy or object from inside the boxes. Your child will then be given the boxes to get the toy or object out of the boxes.

Testing will occur [insert daycare location here]. Your child will be brought to [insert daycare location here] and the examiner and research assistant will complete the activities with him/her. Each child is seen one time for about 10 minutes. I try to make the session as fun as possible. I will take breaks as needed. Upon completion, he/she will receive stickers and a small toy. You will also be entered into a draw for a 1/5 chance to win a $20.00 Chapters gift card. The draw will take place when the study is complete. Participation is completely voluntary. You are free to withdraw at any time for any reason.

The activities will be videotaped and the examiner will record your child's responses. The information collected is confidential. No picture or videotape will be shown publicly. A password protected computer in a locked laboratory will be used to store the videos. This computer is only used for research videos and can only be accessed by the researcher and research assistants. Each child will be given a participant identification number and all data will be labeled only with this number.

We also ask that you complete the attached demographic form. This form will provide us with information about the sample of participants.

A summary of the group results can also be provided. Please fill out the information on the next page if you would like a summary of the group results sent to you.

Your participation will not influence your relationship with DAYCARE or the services you receive.

If you would like your child to participate, please complete the attached consent form and demographic form and place them in the envelope provided (please seal the envelope). Please return these forms to the DAYCARE at your earliest convenience and place them in the [insert location of the drop box]

If you would like more information or have any questions, please contact us directly: Jackie at younglearners.unb@gmail.com or 506-458-7590.

Please do not hesitate to contact me at the above email or phone number with any questions.

I hope you will choose to participate in this project.

If you have any concerns regarding this research that you do not wish to share with the principal investigator, you may contact Dr. Sandra Byers, Chair of the Psychology Department at (506) 458-7803, the Chair of the Psychology Ethics Review Committee, Dr. David Clark at (506) 452-6225, or the chair of the UNB Research Ethics Board, Dr. Steven Turner (506) 453-5189.

Sincerely,

Barbara D'Entremont, Ph.D., L.Psyc.
Professor and Director of Clinical Training

Jackie Normand, B.A. (Hons)
PhD Student, Clinical Psychology

This project is on file with the University of New Brunswick Fredericton REB #.

CONSENT TO PARTICIPATE IN PROJECT AT CHILDCARE FACILITY

PLEASE COMPLETE AND RETURN TO THE CHILDCARE FACILITY

Project Title: Imitation of relevant and irrelevant actions by young children

Principal Investigator: Jackie Normand (Ph.D. Student)

Supervisor: Dr. Barbara D'Entremont, Ph.D., L. Psyc.

Address: Psychology Department, University of New Brunswick **Tel:** 458-7692

I have read the above information and agree for my child to take part in this study
Yes ❑ No ❑

I give permission for my child to be seen at the daycare
Yes ❑ No ❑

I would like to meet with the examiner before the session
Yes ❑ No ❑

If yes, please provide a number and time when we can reach you to arrange a meeting:

I prefer to have someone contact me about bringing my child to UNB campus to participate Yes ❑ No ❑

Parent Name: _____ Phone number: _____

Email: _____

_____ _____

Name of Child Date of Birth

Printed name of parent Signature of parent

_____ _____

Signature of researcher Date

I would like a summary of the group results of the research project Yes ❑ No ❑

Preferred method for receiving results

Home address ❑ Email address ❑*Note that email is not secure

Home address: _____

_____

Email address: _____

CONTACT INFORMATION

Phone number:_____

If your name is drawn for the $20.00 Chapter's gift card, you will be notified via the above phone number and arrangements will be made at that time for you to receive your gift card.

I would like to be contacted about future research
Yes ❑ No ❑

I would like to be contacted about my other children participating in future research
Yes❑ No ❑

Name: _____ Date of Birth:_____

Name:_____ Date of Birth: _____

Appendix L

Study 2: Debriefing Letter

Imitation of relevant and irrelevant actions by young children

PARTICIPANT FEEDBACK FORM

We are interested in how children learn how to use a new object after watching another person use the object. Sometimes children use information about what the object is made of or how it works to decide how to use the object and sometimes children watch how other people use the object and then do the same thing as other people do.

Research has found that children will imitate actions they see an adult make on an object to remove a toy that is in the object even when the actions are not actually necessary for getting the toy. The imitation of actions that are not necessary for removing the toy from within the object is called over-imitation. Children imitate actions that are not necessary for getting the toy when they could have just removed the toy an easier way without the unnecessary actions.

Research suggests that children over-imitate to be social with and to be like the person who models the actions.

To look at this, your child observed two examiners get a toy from inside the same object. One examiner always made unnecessary and necessary actions on the object to get the toy and the other examiner always made just the necessary actions on the object to get the toy. One examiner then left the room and your child was given the object to get the toy out.

This research will tell us whether a social theory explains what children do. If a social theory is supported, children will only copy unnecessary actions when the examiner who made unnecessary actions on the object stays in the room.

If you would like to read more about over-imitation you can find more information here:

Nielsen, M. & Blank, C. (2011). Imitation in young children: When who gets copied is more important than what gets copied. *Developmental Psychology, 47,* 1050-1053.

If you have any questions about this research project you may contact us at younglearners.unb@gmail.com or 506-440-6427 (Jackie Normand) or 506-458-7692 (Dr. Barbara D'Entremont).

If you have any questions or concerns about your rights or treatment as a research participant, you may contact the Chair of the Psychology Research Ethics Committee at UNB, Dr. David Clarke at (506)-452-6225, (clark@unb.ca) or the Chair of the Department of Psychology, Dr. Sandra Byers at (506) 458-7697 (byers@unb.ca).

THANK YOU FOR PARTICIPATING IN THIS RESEARCH PROJECT!

This project is on file with the University of New Brunswick Fredericton REB #

Curriculum Vitae

Candidate's full name: Jackie Marie Normand

Universities attended:

2008 - Present	Ph.D. in Clinical Psychology* University of New Brunswick Supervisor: Barbara D'Entremont, Ph.D. Internship: British Columbia Child and Youth Provincial Residency Program *Full accreditation by the Canadian Psychological Association
2003 - 2007	B.A. (Honours), Psychology University of Guelph Supervisor: Barbara Morrongiello, Ph.D. Thesis: *Mother's and father's reactions to their children in injury-risk situations: Do they take a safety or discipline perspective?*

Publications:

Morrongiello, B. A., Zdzieborski, D., & Normand, J. (2010). Understanding gender differences in children's risk taking and injury: A comparison of mothers' and fathers' reactions to sons and daughters misbehaving in ways that lead to injury. *Journal of Applied Developmental Psychology, 31,* 322-329.

Conference Presentations**:**

Normand, J. M., & D'Entremont, B. (2010, May). *An understanding of sharing, following, and directing attention and behaviour in children with autism*. Poster presented at the International Meeting for Autism Research, Philadelphia, PA.

Normand, J. M., & Morrongiello, B. A. (2007, April). *Mother's and father's reactions to their children in injury-risk situations: Do they take a safety or discipline perspective?* Poster presented at Annual Ontario Psychology Undergraduate Thesis Conference, Toronto, ON.