

# An App to encourage social interaction by children with Autism Spectrum Disorder: A proof of concept study

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## ABSTRACT

Children with Autism Spectrum Disorder (ASD) can demonstrate impaired social and communication skills. This project explored whether the app 'Talk With Me' assisted children with ASD to communicate with others. Eight participant families, with children aged between 3-11 years, were interviewed before and after using the app in their homes or social situations. Children engaged with the app early on, but engagement decreased over the study period, primarily due to the limited number of conversations available to them, which were, for some children, either too hard or too easy or not interesting enough. Most families perceived their child to have gained increased confidence and participation at school, and improved turn-taking during conversations. 'Talk With Me' appears to have potential for assisting children with ASD to develop communication and conversational skills. Further development to enable customisation of the app by families would increase its relevance to individual children's needs and interests.

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## INTRODUCTION

Autism spectrum disorder (ASD) refers to a range of neurological disorders that affect social and communication skills (Lord, Cook, Leventhal, & Amaral, 2000). The disorder is characterised by degrees of impaired social behaviour, deficits in communication and language skills, and by unusual, restricted, or repetitive behaviours (Lord, Cook, et al., 2000). ASD is approximately 4.5 times more common in males than females (Centres for Disease Control and Prevention, 2016b). The prevalence of individuals diagnosed with ASD is markedly increasing with an estimated one in 160 people worldwide (World Health Organisation, 2017), with a prevalence in the

United States of one in 68 in 2016, compared to one in 150 people in 2000 (Centres for Disease Control and Prevention, 2016b). The increasing prevalence is likely due to broadening of diagnostic concepts, service availability and increased awareness of ASD in the lay and professional public (Elsabbagh et al., 2012). ASD affects 1 in 100 people, or approximately 46,930 people in New Zealand (NZ) (Ministry of Health, 2017).

In most cases, the condition becomes apparent in the first five years of life (World Health Organisation, 2017) because of observed differences in behavioural development compared with peers, such as turning away from others during social interactions or having difficulty joining group activities. However,

as it is a spectrum disorder, all behaviours vary in pervasiveness, severity and onset and no two individuals will exhibit all of the same behaviours (Lord, Risi, et al., 2000).

Impaired communication and social interaction are core symptoms of a diagnosis of ASD (Centres for Disease Control and Prevention, 2016a). Difficulty with pragmatics, or the use of language in social contexts, is common in children with ASD (Jones & Schwartz, 2009; L. Koegel, Park, & Koegel, 2014). Such children can have little or no functional speech and reduced engagement in turn-taking or reciprocal conversations. These children may show reduced ability to initiate and expand on conversational topics, ask about the interests of their peers, take into account others' points of view, or provide relevant responses in a conversation (Hadwin, Baron-Cohen, Howlin, & Hill, 1997; L. Koegel et al., 2014; Paul, Orlovski, Marcinko, & Volkmar, 2009; Peterson, Garnett, Kelly, & Attwood, 2009). In typically developing children, a variety of conversation skills, such as question asking, develop early in their preschool years. As these skills become increasingly sophisticated throughout development, this leads to a larger variety of opportunities for social interaction (R. Koegel, Bradshaw, Ashbaugh, & Koegel, 2014). Without systematic intervention, individuals with ASD may be at risk of social withdrawal and isolation (L. Koegel et al., 2014), which could result in difficulty developing and maintaining relationships with others, feelings of loneliness, and higher rates of depression and/or anxiety (R. Koegel, Kim, Koegel, & Schwartzman, 2013; Lord, Risi, et al., 2000).

It is estimated that up to 50 percent of people with ASD do not use speech functionally. Instead, they use an augmentative and alternative communication (AAC) system to supplement their existing speech or act as a primary mode of communication (Mirenda, 2013). Since the development of tablet technology, many communication apps have become available to function as an AAC device, using pictures, symbols and speech generating technology to assist people to express their needs. These apps have become popular as they are relatively low-cost and require considerably less time to set up and maintain than conventional AAC systems (Still, Rehfeldt, Whelan, May, & Dymond, 2014; Xin & Leonard, 2015). However, we believe that although AAC systems are beneficial, they are typically operated by a single user to express their needs, in contrast to enabling a collaborative conversation. For example, when being taught to use an AAC device, making requests is often the initial focus for intervention (Still et al., 2014).

Indeed, much of the research investigating use of AAC devices on tablets for children with ASD is focused on the child's ability to communicate their physical needs or initiate requests. There is little evidence to support use of a tablet or iPad® for collaborative conversation. One study has investigated if teaching communicative turn-taking with an iPad® would promote social interaction in five preschool children with complex communication needs (Therrien, 2016). Four of the five participants had a formal diagnosis of ASD. The participants were provided with an AAC application on an iPad® and received turn-taking training from a doctoral student in special education. The author found that four of the five participants had increased turn-taking in independent sessions with peers.

Although a positive outcome, the study was resource intensive as the participants received turn-taking training between one and three times a week for three months.

Researchers from Callaghan Innovation, a government agency that works to make NZ businesses more innovative through technology, and from the University of Otago have worked together for many years on development and use of technology for children with ASD (Graham et al., 2016; Jordan, King, Hellersteth, Wirén, & Mulligan, 2013; Mulligan et al., 2017; Mulligan, Rowland, Sandland, Potterton, & Kanagasabai, 2015). The intent of this work has been to promote development of skills in social interaction by children with ASD. The study by Graham et al. (2016) investigated use of Talk With Me, an app to encourage social interaction by six adolescents with a diagnosis of ASD aged 12 to 19 years. The study compared use of the app displayed on a large touch pad screen for children to engage in a simple turn-taking conversation with the children's usual way to make conversation, which was via traditional AAC devices and Picture Communication Symbols. It was found that use of the app improved social interaction, attention and independence, and the adolescent participants showed high levels of enjoyment compared to when using their other communication systems. The findings from the Graham et al. study (2016) encouraged us to explore use of the app in the home context.

The intent of the Talk With Me app is for children with ASD to experience, practise and learn what neuro-typical children would consider social niceties of conversation, such as asking questions, turn-taking and providing appropriate answers, and thereby to facilitate development of their social interaction skills. The app has a variety of conversational topics which the children can select to practise sentence development, question asking and turn taking.

## METHODS

This proof of concept study aimed to explore whether the app, 'Talk With Me' when used on an android tablet or iPad®, has potential as a tool for developing communication and conversational skills in children with ASD in the home environment. Participant families with children or adolescents with ASD from a metropolitan area in NZ were recruited via an invitation email from Autism NZ Inc. This nationwide organisation has over 6,300 members consisting of parents and caregivers for children with ASD, teachers, and public interested in the condition (Autism New Zealand Inc., 2017).

Interested parents/caregivers contacted the researchers, who provided them with written information about the study, after which they provided written consent to participate with their child in the study, which was preceded by a first semi-structured interview with parents/caregivers. These interviews were conducted via email or telephone (15 – 30 minutes). Each participant family was then provided access to the app for a period of time (intended to be eight weeks) on their own iPad® or tablet or one belonging to Callaghan Innovation. Brief education on its use was provided by staff of Callaghan Innovation (MK, SG). Participant families were encouraged to use the app with their child to help facilitate communication

through conversation with people, for example, family members and peers. No specific instructions were given as to how often or when to use the app.

A second semi-structured interview was undertaken following 6-8 weeks' use of the app (see Table 1 for interview questions). These interviews were with the parents/caregivers of the child at a place of their choice, with or without the child present, or via

telephone, and took 15-40 minutes. Verbal consent was gained from participant families before audio recording the interviews. We used a qualitative descriptive approach (Vaismoradi, Turunen, & Bondas, 2013) in order to report perspectives of those who hold the knowledge and experience about the topic of interest (Neergaard, Olesen, Andersen, & Sondergaard, 2009). The research was approved by the University of Otago Ethics Committee (ref 11/195).

**Table 1. Semi structured interview questions**

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Before use of the app

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- We would like to learn more about your child/adolescent, about their communication methods and their behaviours.
- Please tell us about your child (for example, how old are they, are they an only child or do they have siblings, what do they enjoy doing, what do they dislike doing .... and anything else you would like to share about your child).
- In what way/s does your child/adolescent currently communicate with their family/peers/strangers?
- How much verbal communication does your child/adolescent have with you, their peers, family or strangers?
- Please would you tell us about your child/adolescent's methods of making their needs known to you, their peers, family or strangers?
- Does your child use sentences to communicate?
- How long are these sentences?
- Is your child able to focus on the topic of conversation and participate in a conversation even if not using words? How long will they do this for?
- Does your child attend to the person talking with them? How long will they do this for? For example, do they make eye contact or show other indications of participating in the conversation?
- Does your child show interest in/communicate about a topic they have not initiated? How long might they do this for, how often might they do this?
- How are your child/adolescent's social interactions with other people, for example other children, their siblings, their friends other adults or strangers?
- Does your child exhibit repetitive or restricted patterns of behaviour? Please explain, we are after as much detail as possible, for example, type of behaviour and when it occurs.
- How much experience with using a tablet does your child have?
- How often does your child/adolescent use a tablet?

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After use of the app

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- As a parent/caregiver, how did you find using the app 'Talk With Me' with your child/adolescent? Please explain – we are after as much detail as possible.
  - How engaged with the app did you and your child remain over time?
  - In your opinion, do you think using the app 'Talk With Me' has made a difference to the manner in which your child/adolescent communicates and interacts with you, verbally and socially, and with others (for example, their siblings, peers, strangers) and participates in family and community life? In what ways? Please explain – we are after as much detail as possible.
  - In what ways do you think the app 'Talk With Me' could be improved/customised for use? Please explain.
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### Data analysis

Data were analysed using an inductive thematic approach (Braun & Clarke, 2006). Each interview was transcribed by a member of the team; a second member reviewed the transcripts for accuracy. Then team members (AE, MG, TR, MS) independently familiarised themselves with the data by reading through each transcript twice, highlighting important features of the data that were relevant to answering the research question and building up a profile of the participating children. Researchers (AW, AE, MG, TR, MS, HM) then worked collaboratively to code a transcript and describe the codes,

thus creating a coding template. AE, MG TR and MS then worked in pairs to code the remaining transcripts using the coding template. Any new codes were discussed by the team before being added to the template. The team then had many discussions about grouping the codes, and synthesised these into sub themes and themes.

### RESULTS

Twenty-one families replied by email expressing interest in the study. Nineteen subsequently requested information and consent forms for the study. Written consent was subsequently

received from nine participant families. Eight participant families agreed to be interviewed before and after using the app and downloaded the app to their personal iPad® or tablet.

The eight child participants in the study were between three and 11 years old (mean age 7.25 years of age) (see Table 2). All participants had experience with a tablet whether it be through school or in the family environment. However, length of use varied from 20 minutes to more than five hours per day. Parents/caregivers reported their children required varying levels of support for verbal and non-verbal communication. None of the children were able to put more than 15 words together in a sentence, and one was only able to say three consecutive words. Five of the eight families said their children had difficulty putting their thoughts into words to express their feelings. Families reported that their child's sentences were commonly disjointed, lacked structure, complexity or the correct tense, and at times made little sense. For example *"he hit my lip in classroom, you know his hand"*. Parents reported children could get lazy communicating with those closest to them as they knew family members would quickly figure out what they required or wished for, so would use few words or point to what they wanted. The children struggled in receiving and comprehending information, finding it a challenge to read a situation. In this regard one parent voiced that his child's mind must be *"a very noisy place"*. Parents reported their child struggled with social cues and conversational etiquette such as turn-taking and acknowledging the other person in a conversation. Children did not typically maintain eye contact with those they were talking to, especially when these were strangers. Many of the children were perceived by their families to want to make friends but lacked the skills to do so.

**Table 2: Demographic information for the eight child participants**

Variable	Values
Sex	
Male	7
Female	1
Age (years)	
Range	3-11
Mean (SD)	7.25 (2.9)
Living with	
Parent(s)	6
Parent + other	1
Grandparent	1
Education	
Primary School	7
Kindergarten	1
Estimated words spoken per sentence (range)	3-15

We identified three themes pertaining to the usability of the app: 'Engagement', 'Transferred Skills and Behaviours', and 'Improving the App' (Table 3).

**Table 3. Themes and subthemes**

Themes	Subthemes
A. Engagement	Initiation Context of use App engagement
B. Transferred Skills and Behaviours	Perceived benefit of app
C. Improving the App	Customisation of the app Target child's ability

### Theme A: Engagement

Engagement encompassed active involvement and interest in using the app. For a child to engage in 'conversation' via use of the app 'Talk With Me', they first needed to initiate the use of it or agree to use it with a partner. Half of the parents reported that it was the parent that initiated use of the app, but once introduced to it, the child found the app fun and interesting. Two children initiated use of the app themselves. The caregiver of one of these children said that the child *"initiated [use of it] also with some of his friends and I think that's a really cool thing"*. Two families perceived that initiation and engagement were difficult, as the app competed with other applications on the tablet. For example, *"he likes it, but yeah when you've got YouTube, minions games and all that sort of other bad things it's a tough competition. It's like comparing, you know, fruit bursts versus [plainer] lollies"*. A parent of one of the youngest children said that her child *"would get out of [the app] and look at YouTube on the iPad" [instead]*.

All children used the app at home. Additionally, three children used the app outside of their homes, two at school with friends, and one with their speech therapist. The participant families approached use of the app in different ways. Over half of them used it as a game. One parent commented, *"it's a game, but then it's real life skills"*. Two families used it as an educational tool for their child, and set aside time for 'homework' in order to get their child to use the app on a daily basis. One child appeared to randomly pick through the conversational pictures with little or no apparent purpose. Two of the parents reported that their child became possessive of the app, not wishing to share it in the intended way with others. These children played both sides of the 'conversation' on the app by themselves.

Initial engagement with the app ranged from five minutes to two hours. Families of those children who used the app for a longer period of time at the beginning of the study reported that this was because their child wanted to explore the app or systematically work through the 'conversations'. However, reported engagement with the app throughout the study period decreased over time. This was true even for the two children who engaged for two hours on first obtaining the app. Families felt that lack of engagement during a 'conversation' and over the study period was due to an array of reasons. These included: the child having a short concentration span, losing interest because the app was too challenging for them, becoming bored because the child could already verbalise the 'conversations', losing interest once completing all the 'conversations', the topics

on the app not falling into the child's area of 'special interest', or the child learning the set 'conversations'. One family, however, reported that their child became increasingly engaged throughout the study period and *"the more he uses it the more he likes it"*.

In summary, this theme demonstrated early engagement with the app, continuing engagement when the app was meaningful or useful to the child, and that engagement ceased when use of the app was no longer meaningful.

### **Theme B: Transferred skills and behaviours**

Some families reported perceived benefits following their child's use of the app. Common transferred skills and behaviours included increased confidence and increased participation at school. One child was able to describe his drawings, which he had not done before, and another was said to be more confident in conversation with friends. Two of the eight families highlighted that the app had aided with learning social norms for communication. An example of this was a child who began to use eye contact and, once finished his turn, would look expectantly at the other person in the conversation and wait for a reply. He had also learned new words from the app and used these appropriately with his parents outside the context of the app. Of the parents who had noticed some benefits of using the app with their child, half were unsure if the behavioural changes they had observed were actually attributable to the app or to something else. In contrast, three families had not observed any changes in communication or participation in conversation with others following the use of the app.

### **Theme C: Improving the App**

Participant families provided several suggestions for improvement of the app. The majority of parents said the app seemed like a good starting point, but needed more development. The ability to personalise or customise the app via the addition of personal images (e.g. photographs), and other 'conversations' was suggested by the majority of the families as a way to increase the level of purposeful use of the app. These families suggested that the addition of being able to add their own photographs would allow the content of the app to become more relevant to their child's context because recognition of meaningful and customisable pictures and phrases would help to increase meaning and engagement for their child. There were many suggestions as to new categories for conversation. Three parents were surprised that there was no category for school, and said that this would be very helpful because it had relevance to their child. Examples of making the app more suited to specific child or family interests were camping, or the game Minecraft®. A category to address social behaviour, emotions, and anxiety was also a suggestion as these were ideas children found difficult to communicate. One parent suggested the app could be used as a tool to prepare the child for new or challenging experiences *"like if it's travel or something like that, you can add photos of the actual things, like what the inside of an aeroplane is going to look like"*.

Four parents suggested having differing levels of challenge within the app. This was because their child appeared to have found it too basic, because the conversations were below the child's literacy level, or alternatively too complex for their level

of understanding. Having the option of longer, more complex conversations and progressions to build on would be of help to some children. There was also a suggestion of adding in a rewards system, for example, through stars or points, to maintain the interest of the child.

Specific features of the app design were identified by parents for improvement. In particular, the font size was deemed too small, and the accent and pronunciation of some words used by the voice in the app sounded foreign. Two parents commented that the conversation was not voiced smoothly, and one commented on the speed of delivery of the speech as being too fast. In summary, this theme shows that customisation and an improved breadth of relevant topics, as well as differing levels of challenge and attention to the voicing on the app should increase the amount of purposeful use of the app.

## **DISCUSSION**

The aim of this proof of concept study was to explore whether the app 'Talk With Me' has potential as a tool for developing communication and conversational skills in children with ASD in the home environment. The eight participant families agreed the app was a good starting point and had potential, although it needed more development if their child was going to stay engaged with it for a longer period of time.

It was the families with children between five and nine years of age who reported positive behavioural changes in their children during the study. This may indicate that the app in its current version is most appropriate for children in this age bracket. However, biological age for children with ASD is not an indicator of their developmental level. Indeed some children may continue to display impaired social behaviour, and deficits in communication and language skills, into their teenage or even later years, depending where they are on the Autism spectrum and/or whether they received appropriate intervention early on. The children of this age in our study exhibited common traits in that they had the desire to be social but struggled to verbalise their thoughts and emotions. In addition, they had a limited attention span, especially with topics they had not initiated. They were selective about who they interacted with and did not maintain eye contact, especially with strangers. Yet, parents reported that during the study period their children displayed improved confidence, turn-taking and increased participation in conversations in their home situation and for some of them, outside of the home environment. These changes however, should not be presumed to be solely attributable to the app. Contextual factors such as social experiences with family and friends, school, extracurricular activities and use of other technology likely influenced children's behavioural communication, as would childhood development. The children from the three families who perceived no particular benefit for their children in using the app were at either end of the three to 11 year age range of our participants. A possible reason for this could be the youngest child's inability to understand the concepts and language of the app, and the older two being more advanced in their communication ability than the app would allow.

The short time period in which the app was trialled may not have been long enough for parents to gauge usability and

applicability of the app. However, as all but one of the children began to disengage within one to two weeks after receiving the app, we suggest that it is not a matter of using the app for longer to see improvements; rather it is about finding ways to increase engagement and usage. Furthermore, participant families all volunteered to take part in the study. This could mean that they had a high level of interest in developing their child's conversation and communication skills and in their child's education and development overall. Many of the parents had actively sought other interventions to improve their child's social and communication skills, for example speech therapy and holiday programmes where children socialise with their peers. This high level of interest in their child may have motivated use and initiation of the app.

An interesting and unforeseen finding from our study was the way in which the app was used by two children who mainly used the app alone, taking part in both sides of the conversation. A large systematic review that focused on the technology most widely used as support for school students with ASD to communicate, suggested that technology can be used to compensate and help students by reducing the anxiety produced by real social situations (Aresti-Bartolome & Garcia-Zapirain, 2014). However, they also argued that if the user only interacts with the technology, this could cause further problems with social relationships and isolation. Although taking part in both sides of a conversation was not how use of the app Talk With Me was intended, it could be argued that there are potential benefits to be gained from this approach. Indeed, listening to the words, saying them aloud, and picking up on the idea of conversational norms of asking questions and receiving replies may be of benefit to a child even if they are not yet capable of taking turns as was the intention of the app.

The ability to customise the app would allow for various levels of ability, different topics of interest and relevance, and personalisation of words and pictures, thus making the app more engaging and effective. The concept of customisation aligns with the study by Aresti-Bartolome and Garcia-Zapirain (2014), which found that most apps for those with ASD are generic, with a lack of an ability to personalise the tool to meet specific needs. The addition of photos of the child and their familiar environment, along with self-selected and meaningful phrases, would therefore be a useful improvement. The children in our study were selective about which things they did and did not like, for example, certain foods and favourite toys or colours. We therefore recommend that the app be extended to include the ability to individually customise it, so that families include meaningful conversations, topics and pictures for their child.

Into the future, we suggest the app should be trialled outside of the home environment, for example, in schools. Furthermore, we agree with our participant families' suggestions that the app has potential for use by children with other communication disorders. However, this would require further trialling after more development of the app itself.

In conclusion, the study found that the app 'Talk With Me' has potential as a useful tool for developing communication and conversational skills in children with ASD, although children

tended to find it difficult to remain engaged with the app and lost interest in its use over time. This innovative app nevertheless has potential, but requires the ability to be customisable to have a wider variety of categories and conversations to improve engagement.

## KEY POINTS

1. Children with ASD engage with technology, therefore an app that encourages development of conversational communication would seem appropriate to minimise social isolation.
2. Unlike other apps, Talk With Me encourages development of two way conversations as opposed to communication for one's needs only.
3. Talk With Me shows promise as a way of including children with ASD in life situations via development of conversational norms.
4. An app such as Talk With Me has potential as a tool for physiotherapists to communicate meaningfully with children with ASD.

## DISCLOSURES

No funding was obtained to undertake this study. Authors report no conflicts of interest.

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