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# Autism Spectrum Disorder on Twitter during COVID–19: Account types, self – descriptions, and tweeting themes

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**ABSTRACT**

Social media can be used to share experiences of health-related conditions, such as Autism Spectrum Disorder (ASD), and to advertise support. Knowledge about how this occurs can inform those seeking to guide those with the condition. This article reports three related studies to investigate ASD on Twitter in the USA, derived from Covid-19 tweets between March 10 and June 30, 2020. Study 1: Twitter accounts mentioning ASD in author biographies were classified with content analysis by type, finding parents and people declaring ASD to be both common, with support, advocates and specialists also represented. Study 2: The biographies of these accounts were analysed using word association thematic analysis (WATA), finding a strong family relationships theme amongst the parent tweeters, for example. The results also suggested common identity aspects of people declaring ASD, including gaming and artistic interests. Study 3: Covid-19-related tweets from the same accounts were analysed using WATA, finding no ASD-specific themes for parents or people declaring ASD. The results suggest that ASD in the USA is represented for Covid-19 through parents, individuals declaring it, and supporters, but without raising concerns particular to the disorder.

**KEYWORDS**

Autism Spectrum Disorder; Twitter; Social media; Covid-19; Parents of ASD children; Autism support

## 1 Introduction

Autism Spectrum Disorder (ASD) is a widespread developmental disorder, for example affecting 1 in 54 out of a large sample (275,419) of 8-year-olds in the USA, with boys being 4.3 times more likely to be diagnosed, and a third of ASD children having an intellectual disability (learning disorder) (Maenner et al., 2020). ASD can substantially impact the families of those diagnosed. Support can be available from psychiatrists, councillors and special education teachers, as well as through literature, ASD organisations and communities. Social media can play a role in the communication and information ecosystem for ASD, with sites like

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Facebook and Twitter enabling people with ASD, supporters, and families to connect with others and share information. For example, 19% of people with ASD in one survey reported Twitter as being their most important social network site (Ward et al., 2018). Social support for ASD is also available on Twitter (Saha & Agarwal, 2016). It is therefore important to assess how ASD is portrayed on Twitter, including the content of relevant posts, their sources and the nature of users that declare a relationship with ASD.

Mental health issues may be exacerbated during COVID-19 restrictions and so there is extra urgency in this context. School closures create extra home education responsibilities for parents, requiring new support strategies (Cahapay, 2020; Majoko & Dudu, 2020). Physical activity may also be more difficult to maintain for people with ASD under lockdowns (Yari mkaya & Esentürk, 2020), and unexpected routine changes may be distressing for some people with ASD (Lodha & De Sousa, 2020). Physical isolation can similarly cause social challenges, mental health and personal protection issues (Courtenay & Perera, 2020; Patel, 2020), and longer-term problems if social distancing measures in some countries cause the temporary withdrawal or modification of some support services (Amaral & de Vries, 2020; Brondino et al., 2020; Cox et al., 2020). Finally, those hospitalised with Covid-19 may need special treatment (Nollace et al., 2020). This article focuses on users tweeting about Covid-19 from the USA and considering ASD to be part of their Twitter identity. The purpose is to identify these users' types, characteristics and Covid-19 concerns so that they and their supporters can plan more effectively.

Previous ASD research about Twitter has usually focused on the content of posts. There are international differences in the extent to which ASD is discussed on Twitter (Quadri et al., 2018). The volume of relevant tweets increased during World Autism Awareness Day 2018, including their positivity (Ahmed et al., 2018). One study found 19 different types of tweet about ASD, but with empowerment or support being the most common single type (48% of high reach tweets; 37% of low reach tweets), with personal impact (2%; 15%) and media sharing (6%; 11%) being next most common (Bellon-Harn et al, 2020). The topic modelling algorithm has also been used to identify ASD themes in tweets (Deriss, 2019). A word frequency comparison of ASD tweets with a control group found that child-related terms to be more prevalent in ASD tweets, suggesting that children are a focus for discussion or support (Beykikhoshk et al., 2015). A more psychological word frequency approach compared the tweets of self-declared individuals with ASD with those of a control group, finding that the ASD users exhibited more fear and stress, tweeted more about one repetitive behaviour and obsessive-compulsive behaviours (Hswen et al., 2019). The impact of news events has also been investigated (Gabarron et al., 2022). The analysis closest to the current paper classified the 100 Twitter accounts that most tweeted #autism or #autismspectrumdisorder into five types of organisation (commercial, non-profit, clinical, academic, and other) or three types of people (with ASD, significant others of people with ASD, and other) (Bellon-Harn et al., 2020). The current article focuses instead on users declaring ASD in their profiles and analyses the content of their self-descriptions.

Given the scarcity of ASD-specific research on Twitter communication, it is useful to review related research for other user groups. Twitter users communicate with an imagined "networked audience" of both personal contacts and online connected strangers, with the latter accumulated over time (Marwick & Boyd, 2011). They are allowed a limited 160-character

profile bio as a relatively permanent identity component. These Twitter bios are a form of social identity (Priante et al., 2016) and can also be used to make political statements, such as #BlackLivesMatter or #AutismAdvocate. One or more of the following types of information is usually included in Twitter profile descriptions: relational (specifying relationships with society or significant others); occupational (career, interests, hobbies); political (affiliation or statements, including social movement membership); ethnic/religious; stigmatized (identification with a stigmatized group) (Priante et al., 2016). This last category (stigmatized) would apply to people with ASD declaring it within their descriptions and all the other categories except ethnic/religious could be directly relevant to some people or groups with a connection to ASD. Twitter profile descriptions can be investigated to identify self-presentation strategies of user groups. For example, the profile descriptions of both Australian journalists (Hanusch & Bruns, 2017) and Finnish academics (Vainio & Holmberg, 2017) tend to be professionally-focused, rarely giving personal information. They can also be used to identify groups for study, such as those self-identifying with cancer (Sugawara et al., 2012), and to differentiate segments within groups (Jaebker, 2020).

This study addresses the lack of research about the social identities of Twitter users that declare a relationship with ASD. It assesses both the types of user that are represented and the nature of these users. The context is users that post about COVID-19, given the increased threat to mental health associated with its restrictions and effects. The focus is not on posts about COVID-19, but on all posts from users that have mentioned COVID-19. The purpose of this focus is to investigate all aspects of the lives of these users, rather than specific COVID-19 issues that they mention.

- RQ1: What types of ASD-relevant account types are common on Twitter during COVID-19?
- RQ2: What types of ASD-relevant identity information are common on Twitter during COVID-19 for each account type?
- RQ3: Do ASD-related accounts tweet about ASD-related topics during COVID-19?

## 2 Methods

This article reports three linked studies to address the research questions. All data gathering and automatic processing used the free Mozdeh software. The following steps summarise the multi-stage approach, which is justified and described in detail in the rest of this section. Studies 2 and 3 use Word Association Thematic Analysis (WATA), which is a mixed methods approach to detect differences between sets of text (Thelwall & Stuart, 2019; Thelwall & Thelwall, 2020). This approach was used instead of standard qualitative approaches, such as thematic analysis (Braun & Clarke, 2006), because it is an exploratory qualitative method that it able to extract patterns from large amounts of social media texts (Thelwall, 2021), including for psychological conditions (Thelwall et al., 2021).

- Tweets mentioning COVID-19 downloaded from Twitter.
- Users posting these tweets identified from the tweet metadata.
- Twitter bios (profile descriptions) for these users downloaded from Twitter.
- Initial ASD tweeter set created from USA users with bios containing ASD terms.
- Study 1: ASD tweeters manually classified by type from their bios using content analysis.
- Study 2: Words occurring disproportionately often in each type of ASD tweeter bios au-

tomatically extracted (WA part of WATA).
    - These words manually analysed with a thematic analysis separately for each profile type (TA part of WATA).
- Study 3: Words occurring disproportionately often in Covid-19 tweets from each type of ASD tweeter automatically extracted (WA part of WATA).
    - These words manually analysed with a thematic analysis separately for each profile type (TA part of WATA).

### 2.1 Data

Twitter does not publish complete lists of users and so an indirect method was needed to identify a sample of ASD accounts active during COVID-19. First, a set of COVID-19 queries was used to retrieve COVID-19 tweets, and the usernames of the tweeters extracted from these. For this, four COVID-19-related queries (Coronavirus,"corona virus", covid-19, covid19) were submitted to Twitter, with an English language filter, through its Application Programming Interface, every 15 minutes from March 10 to June 30 2020, producing over 30 million tweets from 7,791,973 tweeters. The restriction to a single language was necessary because the analysis method works less well on multilingual data, even though Spanish is common in the USA. Second, the usernames of all the tweeters were extracted and the Twitter API was queried for their bios (profile descriptions) and locations.

Users were selected from the complete set identified above when their public Twitter location information mentioned the USA either by name or through the names of US states or major cities. Focusing on a single country greatly reduces the risk that the results are second-order effects of international differences in the diagnosis or reporting of ASD, and the USA is the best option for its large mainly English-speaking population, relatively high rate of Twitter use, and reasonably high rate of ASD discussion on Twitter (e.g., Quadri et al., 2018). Users were then selected when their bios contained one of the terms Autism, Asperger (including Asperger's and Aspergers) or ASD. Although the hashtag #Autis is sometimes used on Twitter, there were no valid uses of it (or the abbreviation Autis) in Twitter bios, so it was not used. These terms produced the basic data set: 1757 tweeters with a US location that had tweeted about COVID-19 between March 10 and June 30, 2020 and apparently mentioned ASD (in any name variant) in their descriptions. Probably a small fraction of Twitter users with ASD report it in their bio, so the method used identifies a fraction of relevant users. This seems to be the only practical approach to generate a sample of users, however. It would be impossible to identify people with ASD that did not mention it on Twitter either in their bio or a tweet, so the sample is necessarily incomplete. In addition, whilst it would be technically possible to download all tweets of all the US users identified and scan them for phrases indicating a claim to be diagnosed with ASD, this was impractical due to the large numbers involved.

### 2.2 Study 1: ASD tweeter account type content analysis

The 1757 users from the USA mentioning ASD in their profiles were classified by account type, using content analysis (Neuendorf, 2016). A set of appropriate categories was constructed based on an initial reading of the bios and each one given a short description. All bios were then independently assigned to one of the categories by two coders. An agreement rate Cohen's kappa of 0.796 indicates substantial (Landis & Koch, 1977) or excellent

(Fleiss, 1981) agreement, reflecting a mostly straightforward classification task. Cases with disagreement were resolved by discussion for the final set.

### 2.3 Study 2: ASD tweeter bio thematic analysis

Word association tests were applied to the five most common types of user identified by Study 1 to identify words that occurred more frequently in bios by the user type than in the bios of users from a comparator set. The comparator set was all bios from US non-ASD accounts (i.e., excluding all accounts from Study 1) for the support type, and all bios from US human non-ASD accounts for the remainder. An account was assumed to be human if it had a male or female first name or listed pronouns in its description (e.g., "Pronouns: she/her"). Human accounts were a more appropriate comparator set for the human autism account types since organizational Twitter accounts are likely to have different contents. Neither comparator set is perfect because their demographics are not matched to the demographics of the ASD sets, which is a limitation that must be taken into account when interpreting the results.

Word Association Thematic Analysis (Thelwall, 2021) was applied to each of the five major types of ASD tweeter as follows. First (the word association stage), for every word in every bio from the specified tweeter type, a 2x2 chisquare test was conducted to assess whether it occurred more often in bios from the type than in bios from the comparator set. Words used less than 10 times were ignored, as too rare to be informative. The words were then listed in descending order of chisquare value and a Benjamini-Hochberg procedure (Benjamini & Hochberg, 1995) used to select statistically significant terms at the p=0.05 level (e.g., Table 1). This produced a set of terms for which the likelihood that *all* are associated with bios from the specified tweeter type is at least p=0.95. For example, the term "amazing" occurred in 5.4% of ASD parent bios compared to 0.4% of non-ASD US human bios, with this difference being statistically significant according to the Benjamini-Hochberg corrected chisquare test.

**Table 1** The top ten words judged to occur in a different proportion of US ASD parent bios (n=541) compared to US non-ASD human bios (n=810,738). Altogether, 465 words were judged to have statistically significant evidence of different prevalence between the two groups, after a Benjamini-Hochberg familywise error rate correction.

| Term | US ASD parents | | US non–ASD | | Chi–square |
|---|---|---|---|---|---|
| | Bios | % | Bios | % | |
| autism | 489 | 90.4% | 0 | 0.0% | 733253 |
| ASD | 42 | 7.8% | 0 | 0.0% | 62944 |
| Asperger | 13 | 2.4% | 0 | 0.0% | 19482 |
| mom | 279 | 51.6% | 30700 | 3.8% | 3361 |
| spectrum | 19 | 3.5% | 268 | 0.0% | 1850 |
| son | 71 | 13.1% | 6033 | 0.7% | 1110 |
| parent | 38 | 7.0% | 2566 | 0.3% | 760 |
| epilepsy | 8 | 1.5% | 130 | 0.0% | 680 |
| neurotypical | 2 | 0.4% | 8 | 0.0% | 596 |
| #autism | 8 | 1.5% | 150 | 0.0% | 592 |

Second (the thematic analysis stage) For each of the five ASD user types, the words judged to statistically significantly associate with them were interpreted using a word-based variant of inductive reflexive thematic analysis (Braun & Clarke, 2013) to organise them manually into relevant themes. Reflexive TA is appropriate because this is a primarily descriptive task. An inductive approach was used in order to let the data drive the themes, in the absence of expectations. The results are subjective to the coders (the authors) and dependant on their knowledge of Twitter conventions and ASD terminology. The TA steps were as follows.

For each user type, each statistically significant term was first given a set of semantic codes (typically short phrases) to characterise its typical meaning in bios. This was achieved through reading at least 10 randomly selected bios from the relevant user type containing the term. This initial semantic step was important because some words were general but used in specific contexts (e.g., "two" was typically used when enumerating children, so was coded "two [children]"). This also serves as a substitute for the usual TA "familiarisation with the data" stage. Second, after all the terms had been coded semantically in this way, the terms were revisited to check and apply succinct single inductive codes that characterised their typical general context. Single themes were applied rather than the usual multiple themes of TA because each data point is a single word, albeit in multiple possible contexts, so has less scope for variety. Third, the themes were compared for internal consistency and difference from other themes, looking to merge similar themes or split inconsistent themes. This was repeated until a final stable collection of themes had emerged from the codes. Fourth, the themes were named and defined. This activity was conducted collaboratively by the two researchers, reaching an agreed set of themes.

### 2.4 Study 3: ASD tweeter Covid–19 tweets thematic analysis

Word association tests were applied to the five largest types of user from Study 1 to identify words that occurred more frequently in Covid-19 tweets by the users of a given type than in tweets by a comparator set. The comparator sets were as for Study 2, except containing the tweets of the users rather than their bios. To prevent prolific tweeters from dominating the results, each user was allowed a maximum of one tweet per week, selected with a random number generator by Mozdeh. Without this precaution, an individual ASD tweeter could generate many significant terms on their own by persisting with a single topic.

WATA (Thelwall, 2021) was applied to each of these sets of tweets, as follows. First, for every word in every tweet posted by an account from the specified set, a 2x2 chi-squared test was conducted to assess whether it occurred more often in tweets from the set than in tweets from the comparator set, with a follow-up Benjamini-Hochberg procedure (as above) to protect against an inflated familywise error rate. Words used less than 10 times by the specified set were judged too rare to be informative and were ignored. The remaining words were then organised into sets using thematic analysis, as above.

### 2.5 Ethics

This study used only fully public data from Twitter: public tweets and public Twitter bios, which it is permissible to analyse without seeking explicit permission, as long as the users are not identified directly (by username) or indirectly (by posting quotes that could be used to identify them) (Eysenbach & Till, 2001; Wilkinson & Thelwall, 2011).

## 3 Results

### 3.1 Study 1: ASD account types

Six common types of ASD-related user were found from the 1738 valid US matches (Table 2). Almost a third of Twitter accounts from the USA with descriptions mentioning autism

were from the parents of ASD children, with just under a quarter claiming to have ASD. Under a fifth were people or organisations offering support and under a fifth were organisations or people (normally individuals) declaring themselves to be autism advocates, campaigners or supporters. A few (7%) declared an interest in autism. The classes are based on the information declared in descriptions rather than attributes of the person. For example, someone declaring themselves to be an autism blogger might have an undeclared reason for this interest, such as an ASD diagnosis or a family member with ASD. The Friends, Other, Unknown and False match classes in Table 2 were ignored for the remainder of this article because the users did not clearly declare ASD.

**Table 2** Manually classified account types for 1738 US tweeters with bios mentioning autism.

| Account type | Tweeters | Description |
|---|---|---|
| ASD parents | 541 (31%) | Parent of autistic child, including indirect statements (e.g., "autism mom"). |
| People declaring ASD | 386 (22%) | Person stating implicitly or explicitly that they have ASD. |
| ASD support | 325 (19%) | Person or organisation offering ASD–related general support, teaching, therapy or another service. |
| Autism advocates | 274 (16%) | Statement that the user is an autism advocate, awareness campaigner, or activist. |
| ASD specialists | 121 (7%) | Specialist researching, tweeting or writing about autism or interested in it. |
| Friends | 11 (1%) | Friend or relative (other than parent) of person with ASD. |
| Other | 1 (0%) | Other defined relationship with ASD. |
| Unknown | 76 (4%) | Unknown or unclear (e.g., "autism has affected our lives"). |
| False match | 19 | No tweeter–ASD relationship (e.g., "memorising baseball scores is Autistic", "I work for ASDS" [typo]) or duplicate account. |

### 3.2 Study 2: ASD tweeter bios

The word association thematic analyses of Twitter bios found themes both related to, and unrelated to, ASD in all cases, except for ASD specialists.

**ASD parents** used a variety of ASD terminology and described the parental relationship using a range of words, although the most common relationship declared was that of a mother of an ASD son (Table 3). Parental statements sometimes expressed positivity about the child with ASD. These statements might enumerate children, mentioning those with ASD amongst these (e.g., three kids, one with ASD). Indirectly related to ASD parenting, some declared a marital status, autism advocacy, or an interest in education. Unrelated to ASD, a small minority of ASD parents (but greater than in the comparator population) declared that they had survived a life-threatening disease. Recall that the context of the terms listed below was detected by reading a random sample of at least ten bios containing them.

**Table 3** Themes for words more prevalent in ASD parents' tweeter bios than non-ASD tweeter bios for the US.

| Theme | Words more prevalent in the ASD parents set |
|---|---|
| Disorder name | autism: 90.4% v. 0.0%; ASD: 7.8% v. 0.0%; Asperger: 2.4% v. 0.0%; spectrum: 3.5% v. 0.0%; with: 26.8% v. 5.2%; has [ASD] : 5.0% v. 0.6% |
| Parent–child relationship | mom: 51.6% v. 3.8%; son: 13.1% v. 0.7%; parent: 7.0% v. 0.3%; boy: 8.3% v. 0.7%; dad: 12.0% v. 2.2%; mama: 4.3% v. 0.4%; mother: 8.3% v. 1.7%; child: 3.5% v. 0.4%; daughter: 5.0% v. 0.7%; kid: 5.9% v. 1.0%; of [ASD child] : 40.3% v. 24.1%; to [and ASD child] : 25.1% v. 14.2% |
| Positivity about ASD child | amazing: 5.4% v. 0.4%; special: 3.0% v. 0.3%; wonderful: 2.0% v. 0.2%; proud: 8.9% v. 2.8%; beautiful: 3.0% v. 0.5% |
| Enumerating children | two: 6.8% v. 0.8%; children: 4.3% v. 0.6%; one: 5.9% v. 1.6% |
| Marital status | wife: 13.3% v. 2.9%; married: 5.7% v. 1.3%; single: 2.2% v. 0.4% |
| Child age | adult: 2.4% v. 0.2%; young: 2.6% v. 0.3%; yr: 2.0% v. 0.3%; old: 3.0% v. 0.8%; year: 4.3% v. 1.6% |
| Autism advocacy/support | warrior: 3.9% v. 0.3%; advocate: 8.3% v. 1.8%; #resist: 3.0% v. 0.7% |
| Teacher or interested in education | ed: 1.8% v. 0.4% |
| Parent is survivor of life–threatening disease | survivor: 2.6% v. 0.5% |

**People declaring ASD** did this using a variety of terminology and gave a range of personal characteristics, rather than focusing on this one aspect (Table 4). These characteristics included name and age, and personal preferences. In addition, the writing style was more frequently personal, using pronouns, rather than list based, compared to the comparator set. In unrelated dimensions, people with ASD reported being artistic, liking anime, being gamers and being, or wanting to be, an actor.

**Table 4** Themes for words more prevalent in the tweeter bios of people declaring ASD than non-ASD tweeter bios for the US.

| Theme | Words more prevalent in the people declaring ASD set |
|---|---|
| Disorder name | autism: 65.0% v. 0.0%; Asperger: 27.2% v. 0.0%; ASD: 11.1% v. 0.0%; spectrum: 9.8% v. 0.0%; syndrome: 7.8% v. 0.0%; functioning: 3.9% v. 0.0%; autistic: 3.6% v. 0.0%; disorder: 3.1% v. 0.1% |
| Personal focus | I: 38.1% v. 11.7%; I´m: 13.7% v. 2.3%; has: 6.0% v. 0.6%; person: 3.1% v. 0.6% |
| Personal information | ([years] old: 7.0% v. 0.8%; name: 3.9% v. 0.4%; years: 6.5% v. 1.6% |
| Preferences | like: 8.3% v. 2.1%; love: 15.5% v. 5.6%; fan: 9.8% v. 4.1% |
| Self–deprecation, "just a guy who…" | just: 6.5% v. 2.4%; guy: 3.6% v. 1.1% |
| ADHD comorbidity | ADHD: 6.7% v. 0.0% |
| Artistic | [drawing] cartoon: 20.5% 13.0%; draw: 2.8% v. 0.1%; artist: 8.3% v. 1.5% |
| Cartoons | anime: 3.6% v. 0.2% |
| Gamer | gamer: 6.5% v. 0.6%; game: 6.7% v. 1.0% |
| Actor | actor: 2.8% v. 0.5% |

**ASD support** Twitter bios mostly focused on autism, offering education, behavioural therapy or other support, for children, adults or families (Table 5). Some people or organisations offering support were also autism advocates or also offered ADHD support.

**Table 5** Themes for words more prevalent in ASD support tweeter bios than non-ASD tweeter bios for the US.

| Theme | Words more prevalent in the ASD support set |
|---|---|
| Disorder name | autism: 92.9% v. 0.0%; ASD: 8.0% v. 0.0%; Asperger: 3.1% v. 0.0%; spectrum: 10.8% v. 0.0%; disorder: 7.4% v. 0.1%; #autism: 3.4% v. 0.0%; individuals [with ASD] : 6.8% v. 0.2%; people [with ASD] : 6.2% v. 1.9% |
| ADHD support | ADHD: 4.3% v. 0.0% |
| Support for children with autism | children: 16.6% v. 0.6%; child: 4.0% v. 0.4%; kids: 5.5% v. 0.8% |
| Support for adults with autism | adult: 8.0% v. 0.3% |
| Support for families with autism | families: 8.0% v. 0.3% |
| Education/training for people with ASD | special: 10.8% v. 0.3%; teacher: 14.5% v. 1.4%; education: 11.1% v. 1.1%; program: 5.8% v. 0.7%; needs: 6.2% v. 0.9%; school: 8.9% v. 1.8%; learning: 4.6% v. 0.6%; training: 3.1% v. 0.4%; student: 7.7% v. 1.8% |
| Behavioural specialist/treatment | behavioral: 4.3% v. 0.1% |
| Therapy | therapist: 4.0% v. 0.2% |
| Organisation providing services | center: 7.1% v. 0.7%; nonprofit: 3.7% v. 0.3%; organization: 3.4% v. 0.6% |
| Autism advocate | advocate: 5.2% v. 1.3% |

**Autism advocates** were disproportionately females in a family context and general mental health advocates (Table 6). Some worked in education, perhaps in a related role. Autism advocates were more likely to sate preferences in their bios and to state animal rights support.

**Table 6** Themes for words more prevalent in autism advocate tweeter bios than non-ASD tweeter bios for the US.

| Theme | Words more prevalent in the autism advocates set |
|---|---|
| Disorder name | autism: 95.3% v. 0.0%; ASD: 3.6% v. 0.0% |
| Autism advocacy/support | awareness: 18.6% v. 0.1%; advocate: 69.3% v. 1.8% |
| Female in family | mom: 1.2% v. 0.2%; wife: 13.1% v. 2.9%; mother: 9.1% v. 1.7% |
| Family focus | family: 6.6% v. 2.1% |
| Mental health advocacy | mental: 5.5% v. 0.3% |
| Education worker | education: 5.5% v. 1.0% |
| Preferences | lover: 10.2% v. 3.6% |
| Animal rights advocate | animal: 5.1% v. 1.1% |

**ASD specialists** often declared an interest in researching the condition (as their specialism) and some wrote about it in addition to, or instead of, research (Table 7).

**Table 7** Themes for words more prevalent in autism advocate tweeter bios than non-ASD tweeter bios for the US.

| Theme | Words more prevalent in the ASD specialists set |
|---|---|
| Disorder name | autism: 90.9% v. 0.0% |
| Research | researcher: 12.4% v. 0.5%; research: 14.9% v. 0.8%; professor: 9.9% v. 1.3%; science: 9.1% v. 1.4% |
| Author | author: 13.2% v. 2.3% |

### 3.3 Study 3: ASD tweeter Covid–19 tweets

The word association analysis found a few relevant themes in all cases except for autism advocates. In general, however, people declaring a relationship with ASD in their bio did not tweet with distinctive enough topics to produce many words for the WATA, especially in comparison to the Twitter biography words. The context of the terms listed below was detected by reading a random sample of at least ten tweets containing them.

**ASD parents** occasionally mentioned autism but did not refer to any specific issues (Table 8). No informative themes were discovered. **People declaring ASD** seemed to give their personal perspective but not to refer to any specific issues. **ASD support** tweets had the clearest focus on autism, and offered advice and support, particularly for families. **Autism advocates** had few tweets about autism in the set and no words met the word association criteria. Both autism and #autism occur in 1.0% of autism advocate tweets, but this included only six tweets each. **ASD specialists** tweeted about the disorder, children, explanations, and the possibility of a Covid-19 vaccine.

**Table 8** Themes for words more prevalent in ASD tweeters' Covid-19 tweets than non-ASD tweets for the US.

| Theme | Words more prevalent in the ASD set |
|---|---|
| **ASD parents** | |
| Disorder name | autism: 2.7% v. 0.0%; #autism: 1.1% v. 0.0% |
| Son with autism | son: 1.2% v. 0.2% |
| **People declaring ASD** | |
| Personal actions and opinions | I: 20.5% v. 13.0%; I’ m: 3.8% v. 1.4% |
| Informal language/agreement | yeah: 1.4% v. 0.2% |
| **ASD support** | |
| Disorder name | #autism: 6.8% v. 0.0%; autism: 9.7% v. 0.0%; #ASD: 1.7% v. 0.0%; |
| Support | cope: 2.0% v. 0.1%; support: 6.2% v. 1.7% |
| General disorders | disabilities: 2.6% v. 0.1% |
| Families | children: 5.1% v. 0.6%; families: 5.1% v. 0.8% |
| Group homes | group: 2.3% v. 0.6% |
| **Autism advocates** | |
| **ASD specialists** | |
| Disorder name | autism: 3.4% v. 0.0% |
| Children | children: 3.8% v. 0.6% |
| Covid–19 vaccine | vaccine: 3.8% v. 0.9% |
| Explanation | mean: 3.8% v. 0.9% |

# 4 Discussion

The results are limited by the period analysed and by the focus on tweets explicitly mentioning Covid-19. It is possible that Covid-19 themes in tweets related to ASD were missed because they tended not to mention Covid-19 directly, although it seems unlikely that important themes were overlooked. The results are also limited to the USA and there would probably be a different breakdown of account types (Study 1) for other countries, including perhaps ASD-specific concerns during national lockdowns (Study 3). An important limitation for the second and third studies is that the comparator groups are not gender matched (not all users had declared or detectable genders) or age-matched (age is rarely declared on Twitter), so some of the differences found might be second order effects of these. For example, the gamer interest for people declaring ASD might be a second order effect if these Twitter accounts were primarily from younger males. Similarly, the enumerating children theme for ASD parents might be common to all parents on Twitter since the comparator set was not restricted to parents. Nevertheless, generalisation limitations are common to all qualitative research, and the themes identified suggest avenues consideration for professionals and for future research explorations.

The tweet results did not find any ASD-specific themes. This does not prove that there are no special ASD considerations during Covid-19, only that the WATA method could not detect any. A prior study found that Philippine ASD parents had created strategies for home education, such as family cooperation (Cahapay, 2020), so perhaps these were not widespread in the USA or they are not specific to ASD. Similarly, no themes related to physical activity were discovered in tweets, despite this being raised as a concern (Yarimkaya & Esentürk, 2020). A study of support for adults at a centre in Italy suggested that staff were able to adapt to the situation so that attendees were not disadvantaged (Brondino et al., 2020). This raises the possibility that the tweet results reflect multiple successful adaptations to the new circumstances.

# 5 Conclusion

In the USA, people that tweeted about Covid-19 and declared an association with ASD were predominantly parents, with people declaring ASD, autism advocates, and ASD specialists also represented. The association analyses on the Twitter biographies of these groups discovered a range of factors that were more common for these groups than a comparator set, such as an interest in cartoons, drawing and gaming for people with ASD, and animal rights concerns for autism advocates. This information may be useful for those seeking to understand the nature of the ASD environment on Twitter and the type of people that engage with the condition. In contrast, the lack of significant results in terms of ASD-relevant tweeting themes, suggests that the threat from Covid-19 and the associated safety measures have not generated widespread problems that are particular to ASD in the USA, unless these problems were not discussed on Twitter (e.g., because they were private).

# References

Ahmed, W., Bath, P. A., Sbaffi, L., & Demartini, G. (2018). Measuring the effect of public health campaigns on Twitter: the case of World Autism Awareness Day. In *International Conference on Information* (pp. 10–16).

Berlin: Springer.

Amaral, D. G., & de Vries, P. J. (2020). COVID–19 and Autism Research: Perspectives from around the globe. *Autism Research, 13* (6), 844.

Bellon–Harn, M. L., Ni, J., & Manchaiah, V. (2020). Twitter usage about autism spectrum disorder. *Autism, 24* (7), 1805–1816. https://doi.org/10.1177/1362361320923173

Benjamini, Y., & Hochberg, Y. (1995). Controlling the false discovery rate: A practical and powerful approach to multiple testing. *Journal of the Royal Statistical Society: Series B (Methodological), 57* (1), 289–300.

Beykikhoshk, A., Arandjelović, O., Phung, D., Venkatesh, S., & Caelli, T. (2015). Using Twitter to learn about the autism community. *Social Network Analysis and Mining, 5* (1), 1–17.

Brondino, N., Damiani, S., & Politi, P. (2020). Effective strategies for managing COVID–19 emergency restrictions for adults with severe ASD in a daycare center in Italy. *Brain sciences, 10* (7), 436. https://doi.org/10.3390/brainsci10070436

Braun, V., & Clarke, V. (2013). *Successful qualitative research: A practical guide for beginners*. London, UK: Sage.

Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology, 3* (2), 77–101.

Cahapay, M. B. (2020). How Filipino parents home educate their children with autism during COVID–19 period. *International Journal of Developmental Disabilities*. https://doi.org/10.1080/20473869.2020.1780554

Courtenay, K., & Perera, B. (2020). COVID–19 and people with intellectual disability: Impacts of a pandemic. *Irish Journal of Psychological Medicine, 37* (3), 231–236. https://doi.org/10.1017/ipm.2020.45

Cox, D. J., Plavnick, J. B., & Brodhead, M. T. (2020). A proposed process for risk mitigation during the COVID–19 pandemic. *Behavior Analysis in Practice, 13*, 299–305. https://doi.org/10.1007/s40617–020–00430–1

Deriss, M. J. (2019). Review of topics related to autism spectrum disorder on Twitter. *Network Modeling Analysis in Health Informatics and Bioinformatics, 8* (1), 14.

Eysenbach, G., & Till, J. E. (2001). Ethical issues in qualitative research on internet communities. *BMJ, 323* (7321), 1103–1105.

Fleiss, J. L. (1981). *Statistical methods for rates and proportions* (2nd ed.). New York: John Wiley.

Gabarron, E., Dechsling, A., Skafle, I., & Nordahl–Hansen, A. (2022). Discussions of Asperger Syndrome on social media: Content and sentiment analysis on Twitter. *JMIR Formative Research, 6* (3), e32752.

Hanusch, F., & Bruns, A. (2017). Journalistic branding on Twitter: A representative study of Australian journalists´ profile descriptions. *Digital Journalism, 5* (1), 26–43.

Hswen, Y., Gopaluni, A., Brownstein, J. S., & Hawkins, J. B. (2019). Using Twitter to detect psychological characteristics of self–identified persons with autism spectrum disorder: A feasibility study. *JMIR mHealth and uHealth, 7* (2), e12264.

Jaebker, L. M. (2020). *Exploring the role of social identity and social media in understanding hunters´ perceptions of wild pigs and their management in the US.* 2020–CSU Theses and Dissertations. https://mountainscholar.org/bitstream/handle/10217/208514/Jaebker_colostate_0053N_16065.pdf?sequence=1

Landis, J. R., & Koch, G. G. (1977). The measurement of observer agreement for categorical data. *Biometrics, 33* (1), 159–174.

Lodha, P., & De Sousa, A. (2020). Mental health perspectives of COVID–19 and the emerging role of digital mental health and telepsychiatry. *Archives of Medicine and Health Sciences, 8* (1), 133–139.

Maenner, M. J., Shaw, K. A., Baio, J. et al. (2020). Prevalence of autism spectrum disorder among children aged 8 years –autism and developmental disabilities monitoring network, 11 sites, United States, 2016. *MMWR Surveillance Summaries, 69* (4), 1–12.

Majoko, T., & Dudu, A. (2020). Parents´ strategies for home educating their children with Autism Spectrum Disorder during the COVID–19 period in Zimbabwe. *International Journal of Developmental Disabilities.* https://doi.org/10.1080/20473869.2020.1803025

Marwick, A. E., & Boyd, D. (2011). I tweet honestly, I tweet passionately: Twitter users, context collapse, and