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**Let me be understood: A behavioural investigation of effective functional
communication skills within a New Zealand special education high school.**

A thesis
submitted in partial fulfilment
of the requirements for the degree
of
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(Behaviour Analysis)
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Abstract

Effective functional communication skills are socially significant behaviours that afford individuals the ability to self-advocate and realise their full range of human rights. The aim of this study was to describe communication skills observed within a New Zealand special education high school routine with three female students (who had previous experience with Augmentative and Alternative Communication (AAC) systems), and the responses provided by staff, within a verbal behaviour framework. In-person naturalistic observations using event-recording procedures were conducted over 18 total hours and 432 total communicative episodes were documented. Communicative episodes were described congruous with Skinner's (1957) account of verbal operants and rates were calculated. Data related to antecedent conditions that occasioned episodes and students' use of communication skills including the function and mode of communication were included. Staff responses to student initiations were assessed as being functionally appropriate matches. Overall, students were involved in approximately 25 communicative episodes per hour that were primarily opportunities to respond, with the exception of one student, and one opportunity to initiate was observed during the entire study. Communicative episodes predominantly occurred with adults, and students used vocals or gestures but rarely AAC systems, during episodes that were most often coded with tact or intraverbal functions. Staff presented additional prompts, mostly using aided AAC systems, during the majority of opportunities to respond they presented. Just over half of staff responses to student initiations were assessed as potentially matching the communicative function. A verbal behaviour discussion of key findings and theoretical and educational implications for practice is provided. Strengths and limitations of this study are identified, and future research is suggested.

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Introduction

Effective communication skills are socially significant behaviours because they are crucial in the overall defence of basic human rights; vital to communication skills being effective is that they are understood by others. Communicative interactions facilitate; access to basic wants and needs, building and maintaining relationships with others, full community participation (including the right to education and work), exercising the right to freedom of opinion and self-advocacy, and the right to national and global level participation (Brady et al., 2016; Jagoe, 2018; McEwin & Santow, 2018; McLeod, 2018; Sen, 2015). Individuals who do not communicate effectively using speech or written language, have a restricted ability to express their basic wants and needs (Brady et al., 2016; Sigafos & Gevarter, 2019). Ineffective communication skills reduce people's independence, which can create a reliance on others for support (Howlin & Moss, 2012; Light & McNaughton, 2015; Light, McNaughton, Beukelman, et al., 2019; Smith et al., 2020). Those with limited communication skills are subject to reduced opportunities to meaningfully participate in contexts important to their lives, often resulting in marginalisation, exclusion, and social isolation (Howlin & Moss, 2012; Jagoe, 2018; Light & McNaughton, 2015; Light, McNaughton, Beukelman, et al., 2019; McLeod, 2018; Sigafos & Gevarter, 2019; Smith et al., 2020). Individuals with ineffective communication skills who are victims of a crime or are experiencing medical needs are grossly restricted in their ability to communicate these experiences to seek support and feel safe (Light & McNaughton, 2015). Some individuals with ineffective communication skills are also at an increased risk of developing challenging or inappropriate behaviours, and the development of these unwanted behaviours can further impede full participation and social inclusion (Dominick, Davis, Lainhart, Tager-Flusberg, & Folstein, 2007; Howlin & Moss, 2012; Light & McNaughton, 2015; Light, McNaughton, Beukelman, et al., 2019; Smith et al., 2020).

The daily challenges and barriers to social participation encountered by individuals with ineffective communication skills intensify with age (Smith et al., 2020). Those who reach adulthood without acquiring an effective communication repertoire (compared to those with functional speech) were more likely to have poorer overall social outcomes (Howlin & Moss, 2012; Smith et al., 2020) including educational achievement, employment opportunities, and social systems (Light & McNaughton, 2015; Smith et al., 2020). Given the negative effects of ineffective communication skills on overall wellness in this population, the significance of acquiring effective communication skills cannot be overstated. Effective communication skills are therefore essential clinical and educational learning outcomes, making communication skills assessments and interventions, and the theoretical framework from which they are informed, critical areas of study (Smith et al., 2020; Tager-Flusberg et al., 2017; Tincani, Miller, Lorah, & Nepo, 2020).

Literature Review

Individuals with Ineffective Communication Skills

While some children with developmental disabilities (including Autism Spectrum Disorder (ASD)) are able to effectively use spoken language to communicate, the exact proportion of individuals who remain ineffective communicators despite intensive speech therapy is unknown, but estimations are between 25% and 35% (Rose, Trembath, Keen, & Paynter, 2016; Tager-Flusberg & Kasari, 2013). The prevalence of young children with ASD who are minimally vocal (based on speech output) in Australia was found to be 26.30% (Rose et al., 2016). Smith et al. (2020) surveyed an Irish adult population with intellectual disabilities, and 23.50% of participants reported they were not able to communicate at all (through speech, sign, or other means), which was rated as being indicative of severe communication impairment. In their research, Sutherland et al. (2014) appraised the communication intervention needs of adults in residential facilities in New Zealand ($N =$

2356) and found nearly 30% were contenders for communication intervention. So the development of an effective communication skill repertoire remains a socially significant learning outcome for those who remain minimally communicative even after years of intervention (Ronski, Sevcik, Barton-Hulsey, & Whitmore, 2015; Rose et al., 2016).

Problematic to communication interventions is that individuals can experience impaired communication skills for a variety of reasons and diagnoses; consequently, they have varying communication skill needs (Brady et al., 2016; Sigafoos & Gevarter, 2019). For individuals with physical motor and/or acquired disabilities that have impeded or removed their facility of speech, but who have learned to communicate for a purpose at some stage, the goal of communication intervention may be to simply provide and teach them how to use an alternative to speech. In contrast, the population of individuals with developmental disabilities who have impaired communication skills (typically these are diagnoses of autism spectrum disorders (ASD) characterised by deficits in social and communicative development) (American Psychiatric Association, 2013) may have different needs to those with impaired speech alone. Individuals within the latter population who also have speech impairments in addition to not having yet acquired many communication skills have broader communication impairments and intervention needs. These individuals with developmental disabilities may have not yet learned to communicate for a purpose, via any means. They may not even know that words can be used for a purpose (such as to obtain desired outcomes and communicate their needs and wants) or that words in any form are essentially symbols and that they actually stand for particular things. Further, some individuals within this population can develop limited spoken language but may not have developed the communication skills required to use these vocalisations purposefully. These vocalisations tend to demonstrate echolalia, scripted or rote responding, or stereotypical vocalisations (Tager-Flusberg & Kasari, 2013). Additionally, some individuals exhibit an array of atypical and challenging

behaviours that often have a communicative function (Dominick et al., 2007; Smith et al., 2020). In some instances, these limited spoken vocalisations and some unwanted communicative behaviours (such as squealing or grabbing at items) may produce the desired outcome, but these types of communicative behaviours are often unreliable, ineffective, and are generally unacceptable means of communicating.

Those with broader communication skill impairments may have quite different intervention needs than those with speech impairments alone (Bondy, 2019). These individuals are a heterogeneous population with a diverse range of communication skill impairments (Brady et al., 2016; Tager-Flusberg & Kasari, 2013) so it is critical to scrutinise the efficacy and suitability of the assortment of communication interventions targeting their specific needs (Brady et al., 2016; Ganz et al., 2017; Ronski & Sevcik, 2018; Sigafoos & Gevarter, 2019). Bondy (2019) noted that for individuals with communication skills deficits and speech impairment, a vital but frequently overlooked matter is an assumption of these individuals understanding the purpose of communicating, despite few of their behaviours being communicative. Consequently, both populations are often assumed to have the same communicative learning and intervention needs so are often treated similarly. Communication interventions that are designed to replace an already established communicative repertoire with an alternative modality, must be separated from teaching communication skills to someone not yet demonstrating evidence of communicatively effective behaviours (Bondy, 2019).

Theoretical Framework

Structural and Functional Accounts of Communication

Several structural and functional theories have been proposed to elucidate communication skill and language development in humans (Novak & Pelaez, 2004; Pierce & Cheney, 2017; Sundberg, 2014a).

Communication from a structural psycholinguistic perspective.

A biological or nativist theory (Novak & Pelaez, 2004) is a structural account of communication skills where unobservable biological structures are thought to be responsible for language abilities (including universal grammar) in humans (Chomsky, 1975). Within this theory, human communicative abilities are thought to be acquired via a hypothetical language acquisition device (LAD). The LAD, from a cognitive or psycholinguistic perspective, is an internal processing system thought to reside within the brain that is said to enable the storage and processing of language (Novak & Pelaez, 2004). Psycholinguistic accounts of language have largely focussed on the topography of communication skills in spoken and written (or manual sign) forms, and the meanings of words, sentences, and articulations used (Novak & Pelaez, 2004; Pierce & Cheney, 2017; Sundberg, 2014a). Within psycholinguistic frameworks, limited attention has historically been paid to the function of communication (the purpose of the communicative exchange), but there now appears to be an increased emphasis on pragmatics which has sparked an interest in the functions and processes of communication (Novak & Pelaez, 2004; Pierce & Cheney, 2017; Sundberg, 2014a).

This structural psycholinguistic account of communication typically positions the role of a speaker as using expressive communication, and the listener role involving receptive communication skills (Pierce & Cheney, 2017). Within this account, the role of the speaker is to encode the meaning of the words they use and transmit this meaning (semantics) to the listener to decode, both roles are theorised as being two expressions of the same type of communication skills (Pierce & Cheney, 2017; Sundberg, 2014a). Communication is thought to develop through exposure alone (and referred to as language input through hearing and seeing language being used) that is then encoded and stored for future recall (Novak & Pelaez, 2004; Pierce & Cheney, 2017; Sundberg, 2014a).

Functional accounts of communication.

Functional accounts of communication and use of language are unique in comparison to structural explanations (Novak & Pelaez, 2004; Pierce & Cheney, 2017).

Communication from a social learning perspective

Vygotsky (1962) proposed external causations of language development when he stated that language is learned and results from an individual's current state, their history of reinforcement, and other influences within their environment (including culture). Vygotsky emphasised that language and communication skills are developed through reciprocal interactions with others, but cannot be learned from exposure alone. Vygotsky's overall explanation of learning language and communication skills, and his concepts of scaffolding, zone of proximal development, and cultural tools, align with a more functional account of communication and language as being learned through interaction with the environment.

Communication from a functional (Skinnerian) perspective

The field of Applied Behaviour Analysis (ABA) is an area within psychology that scientifically studies the environmental variables that influence learning to change socially significant behaviours (Cooper, Heron, & Heward, 2014; Pierce & Cheney, 2017). Skinner (1957) sought to operationally define communication skills to better enable a scientific examination of communication and use of language. A behavioural analysis, provided by Skinner (1957), re-framed communication as verbal behaviour that is "behavio[u]r reinforced through the mediation of other persons" (Skinner, 1957, p. 2). Skinner (1957) stated that verbal behaviour has no special properties and observes no special laws when compared with other types of behaviour. According to Skinner's analysis, verbal behaviours are learned responses (verbal operants) under control of the same types of environmental variables and subject to the same behavioural principles, as other operant behaviours. Examples of these behavioural principles include, stimulus control, contingencies of reinforcement, and

motivating operations (see Skinner (1953) and Michael (1982, 1993, 2000) for further explanations of these fundamental behaviour principles of learning).

When viewed in this way, communicative interactions are things that people do, not something they have, so can instead be thought of as *linguaging* to better reflect and describe the acting out of language (Von Tetzchner, 2018). Communicative behaviours can be defined as a change via verbal behaviour in the relationship between a person and their environment, and verbal operants are learned and shaped by contingencies of reinforcement in the same way other operant behaviours develop (Skinner, 1957). The verbal operants proposed by Skinner (1957) are understood, and functionally defined, in terms of the environmental context that occasion them (stimulus control). Verbal behaviours are therefore controlled by the antecedent conditions (including motivating operations and prior histories of reinforcement) and consequences of the verbal behaviour that are supplied by the communication partner (listener). Motivating operations describe the antecedent conditions relative to individuals at any specific time that temporarily alter the value of a reinforcer. For example, the antecedent conditions of not having something required to satisfy a need or to complete a task temporarily alters the value of obtaining that specific thing. Verbal behaviours develop because of their usefulness in gaining reinforcement and controlling the environment (shaped from the history of being reinforced by other people), and verbal behaviour enables people to better adapt to their environment (Novak & Pelaez, 2004; Pierce & Cheney, 2017).

Functional communication skills

Positioning verbal behaviours as learned operant responses is an important theoretical assumption because it also means that verbal behaviours can be taught, using the same principles of learning used with other operants behaviours, all of which affords hope of learning to be effective communicators for those experiencing communication difficulties.

Within a verbal behaviour framework, the term *verbal* is not to be confused with *vocal* (Novak & Pelaez, 2004; Sundberg, 2014a). Vocalisations (or speech) are not essential, both vocal and non-vocal (such as gestures, use of aided communication, or manual sign) can be verbal, as long as the act meets Skinner's definition of verbal behaviour. To reflect this distinction, the term *verbal behaviour* is used in this research to include communicative behaviours in any mode and the word *vocal* is used to refer to spoken communication acts. *Verbal approach* or *perspective* is used to describe a functional account of language development. When identifying verbal operants within a Skinnerian functional account of communication, it is the controlling variables (antecedent and consequences) that classify the function of the communicative episode rather than the topography or form of the 'word' used or the conversation topic of the exchange. Within a verbal account, 'words' can take any form, for example, vocalisations, use of aided communication system, or manual sign. Although the specific form or mode of the communicative exchange does not define the behaviour, a communicative modality of some sort is generally required to enable an exchange between speakers and listeners. Emphasising the function of communicative behaviours, where other accounts might instead focus on the communicative form, Skinner (1957) proposed several functionally independent verbal operants. For the purposes of this study, the focus will be on the four fundamental operants: mand, tact, intraverbal, and echoic.

Mands can be broadly described as requests. More specifically, verbal behaviours with mand functions refer to when a speaker requests, commands, or demands what they need or want (or want to reject). Mand behaviours can include requests for tangibles, information, attention, escape, or removal of aversive stimuli (Skinner, 1957). Mands are under the control of motivating operations and specific reinforcement, and occur when the speaker indicates to a listener that a specific reinforcer (or the removal of something specific) is the desired outcome (Michael, 1982, 1993, 2000; Skinner, 1957). A mand example is when a speaker

requests a pen, within the antecedent conditions that a pen is required to complete a task and the speaker does not have a pen (motivating operation). Verbal behaviour directed towards another person (in any modality) that conveys the speaker's need for a pen, such as asking, *I want a pen* (mand for an item) or *where is a pen?* (mand for information) is referred to as mand behaviour. A functionally appropriate consequence following mand behaviour is the listener's mediation of specific reinforcement (Skinner, 1957). In this example, the communication partner (listener) providing the speaker with access to a pen or information regarding the location of a pen would be considered consequences that are functionally appropriate matches to the mand function. The consequences following all verbal operants are crucial to the development and maintenance of verbal behaviours, but are particularly important with mands because they are the first verbal operants acquired and are the only verbal operant that directly benefits the speaker with the provision of specific reinforcement (Skinner, 1957). Mands, therefore, play an essential role in the everyday exchanges between people because they afford the speaker the ability to regulate the delivery of reinforcement when a specific reinforcement is most valuable to them, to self-advocate. Mands are important to individuals in the early stage of learning communication skills because mand-based behaviours help establish that there is a communicative purpose and the roles of speaker and listener, thereby contributing to further verbal behaviour development. Individuals who fail to develop mand behaviours may develop challenging behaviours which then serve the same function (to control their environment) (Pierce & Cheney, 2017).

Generally, tact behaviours can be described as comments. The verbal operant Skinner (1957) called tact is a verbal response controlled by the presence of non-verbal stimuli that signals reinforcement is available (discriminative stimuli) which set the occasion for probability of tact behaviour in the presence of that stimuli (under stimulus control). Tacts occur when the speaker names or labels items, events, or actions that they are in direct

contact with and these stimuli can be visible or not visible (Skinner, 1957). For example, the presence of hunger or pain stimuli are not visible but the presence of a pen is a visible non-verbal stimulus. An example of a tact is using the ‘word’ *pen* when seeing a pen (non-verbal stimulus) or commenting that *the pen is blue*. Tacts are maintained by generalised conditioned (social and educational) reinforcement provided by listeners. Functionally appropriate consequences of a successful tact include when the communication partner (listener) provides generalised conditioned reinforcement such as *yes, that is a pen* or *yes, the pen is blue*. Tact behaviours are important because they allow a speaker to comment or report on events and objects present in the environment that individuals are in direct contact with, consequently tacts are frequently the key focus of communication interventions (Sundberg, 2014a).

Echoic verbal behaviours can be described as a speaker producing an imitation of another person’s verbal behaviour. Echoic responses occur when speakers’ responses to verbal stimuli are an exact copy (the response has point-to-point correspondence and is emitted in the same form and modality) of the preceding antecedent verbal stimuli that occasioned the echoic behaviour (Skinner, 1957). An example of echoic behaviour is vocalising the word *pen* after hearing *pen* (antecedent verbal stimulus) or pointing to the same picture of *pen* immediately following another person modelling the verbal action of pointing to *pen* on a picture of a pen. Echoic verbal operants also are maintained by generalised conditioned social reinforcement (social and education), such as praise and attention, provided by the listener (Skinner, 1957). Consequences that might constitute functionally appropriate matches to echoic behaviours include the listener providing praise and attention by saying, *yes, a pen, good talking* or *yes, it is a pen, I like how you used your communication board*. Echoic behaviours are vital in teaching communication skills because they assist in teaching more advanced (complex) verbal behaviours (Sundberg, 2014b).

In general, intraverbal interactions are verbal responses that occur as a result of questions or comments produced by others. Skinner (1957) described intraverbal operants as those that are controlled by the verbal behaviour of others (verbal discriminative stimuli), and intraverbal exchanges occur when speakers' response does not have point-to-point correspondence to the question or comment (the speaker produced a differential response to the antecedent verbal stimuli) (Skinner, 1957). An example of an intraverbal is if a student is asked, *what colour is the pen?* and the student replies vocally with *blue* (the response has no point-to-point correspondence with the antecedent verbal stimuli). Intraverbal responses are maintained by generalised conditioned social reinforcement provided by the communication partner (listener). A functionally appropriate consequence of intraverbal behaviour might be that the listener responds by saying *that's correct, the pen is blue, well done* which may also be accompanied by other forms of generalised social reinforcement such as a high-five gesture. Intraverbal responses are essential skills in a complete verbal behaviour repertoire because they enable individuals to learn other verbal and non-verbal behaviours, and to participate in conversations by answering questions and discussing events and objects that individuals are not in direct contact with including past and future events (Sundberg, 2014a). Intraverbals (in general) are more challenging to learn than other verbal operants, so it is recommended that teaching intraverbal responses should only occur after the learner has established mand, tact, and echoic responding skills (Bondy & Frost, 2001; Frost & Bondy, 2002; Sundberg, 2014b; Sundberg & Partington, 2013). As indicated by the pen examples earlier, while the word *pen* is used in each example (and *pen* is topographically similar in form each time), the communicative function or the purpose of the communication act is dependent on the environmental conditions controlling the behaviour.

Multiply controlled verbal operants

The verbal operants described above are descriptions of the verbal behaviours in their purest form. The reinforcement contingencies and stimuli controlling verbal behaviours are multifaceted, understated, and malleable (Michael, Palmer, & Sundberg, 2011; Pierce & Cheney, 2017). Pure verbal operants (only controlled by one functional variable) rarely occur in real-life contexts, instead, most verbal behaviours are multiply controlled (Michael et al., 2011). Skinner (1957) described verbal operants under the functional control of multiple antecedent and consequence conditions as impure and stated that any verbal episode “will be a function of many variables operating at the same time” (p. 228). A common example of multiply controlled verbal operants is the combination of motivating operations and non-verbal discriminative stimuli present in the environment, which result in verbal behaviours that have both mand and tact functions (Bondy, Tincani, & Frost, 2004). A mand/tact example occurs when a speaker requests a pen (mand) when a pen is present in the environment (tact).

As Bondy (2019) noted, when considering antecedents, identification of spontaneity is important and from a verbal behavioural perspective if communicative exchanges are prompted by verbal stimuli (such as a question from a communication partner) or are multiply controlled, instances of these communicative episodes cannot be credited as spontaneous. Initiations that are truly spontaneously from a verbal behaviour perspective are independently produced communicative behaviours such as pure mands and tacts, and these pure operants are one of many indicators of a robust and functional communication skill repertoire. Although most verbal behaviour is multiply controlled, the pure verbal operants are the foundation for developing a more advanced and complete repertoire of communication skills (Bondy et al., 2004; Michael et al., 2011). In his analysis, Skinner (1957) proposed that a comprehensive verbal behaviour repertoire includes each of the fundamental operants, and evidence of the separate speaker and listener roles.

The verbal community and the important roles of speaker and listener

Skinner's (1957) account of the roles of speaker and listener during episodes of verbal behaviour is inconsistent with psycholinguistic conceptualisations of these roles. Skinner distinguished between the behaviours of the speaker and listener and focussed on the speaker. Verbal episodes (communicative exchanges) typically involve both a speaker and a listener, who interact within what Skinner described as a verbal community. The listener mediates reinforcement of the speaker's verbal behaviours, so verbal behaviours are inherently social. The verbal behaviour of the speaker affects the listener, and when a verbal response from the listener is elicited, at that point, the listener then becomes the speaker (Skinner, 1957). Skinner also positioned the listener role to include acting as an audience (discriminative stimuli that signal reinforcement for verbal behaviour is available) that occasions the verbal behaviours of speakers (under stimulus control) in instances where verbal behaviour has been previously reinforced in the presence of the other people. Not all verbal behaviours necessitate a verbal response from the listener; some verbal behaviours (such as instructions) can function to elicit non-verbal responses from the listener (Skinner, 1957). For example, the listener may give the speaker the requested item or comply with the speaker's instruction. Skinner (1957) stated that listeners could be described as *understanding* the verbal behaviour by their behavioural response (verbal or non-verbal appropriate consequence produced by the listener) (p. 277). The verbal community influences the learner's development and maintenance of verbal behaviour by providing environmental contingencies. Consequently, communication environments that serve to reinforce learning and practicing a full range of verbal operants can be considered facilitative, whereas communication environments that do not support communication skill development can instead be considered compensatory. Within this verbal approach, the crucial role of the responses produced by listeners and their

mediation of functionally appropriate consequences in reinforcing (increasing the occurrence of) the verbal behaviours of speakers, is evident.

Consequences of verbal behaviour

Consequences of verbal behaviours, provided by the listener, can include praise, attention, correction, no response, help or assistance (including supplying information), escape or avoidance, and tangible access (Cooper et al., 2014; Novak & Pelaez, 2004; Pierce & Cheney, 2017). The extent to which the consequences provided by communication partners (listeners) can be described as appropriate matches, is (as outlined earlier) dependent on the function(s) of the verbal episode. The consequences that follow communicative episodes with a mand function are particularly important because mand behaviours are appropriately reinforced with direct and specific reinforcement, and occur in the presence of speakers' motivating operations. Attention to the speaker's ability to effectively convey their message, and to the listener's ability to understand the speaker's communicative attempts to then be able to provide functionally appropriate responses accordingly, is warranted.

Conceptual common ground.

Conceptual disagreement in regards to how communication and language skills in humans develop, and how to define these skills, remains (Ronski & Sevcik, 2018; Trembath, Paynter, Sutherland, & Tager-Flusberg, 2019). As a result, how communication skills are assessed (and therefore how skill impairments are identified) is contested, which ultimately affects practice and how communication interventions and treatments are applied.

Irrespective of theoretical position, those working with individuals who have ineffective communication skills share the same goal for their learners (Frost & Bondy, 2006; Horton, 2020). A behavioural goal to help learners "acquire robust functional communication skills that are readily used in various settings and with numerous potential communicative partners" (Bondy, 2019, p. 352). A linguistically oriented goal to assist learners is to develop

“a range of skills so that they can communicate competently in the real world” (Ronski & Sevcik, 2018, p. 258). The two disciplines also share some common ground in relation to some of the teaching and learning strategies employed in communication interventions. These are sometimes applied behavioural techniques such as shaping, modelling, prompting, time delay, use of reinforcement, and incidental or naturalistic teaching, (Bondy & Frost, 2001; Frost & Bondy, 2002; Novak & Pelaez, 2004; The American Speech-Language-Hearing Association, n.d.).

Although the two disciplines are both targeting communication skills, they do not share the same conceptualisation, analysis, or terminology which can lead to miscommunications (Donaldson & Stahmer, 2014; Horton, 2020; LeBlanc, Sidener, & Firth, 2006; Sundberg, 2016). Skinner’s (1957) analysis of verbal behaviour contrasts with the structural approaches to communication that are typically employed in communication-based intervention research and practice within speech language therapies (Carr & Miguel, 2013; LeBlanc et al., 2006; Von Tetzchner, 2018). But, as Von Tetzchner (2018) highlighted, Skinner’s verbal behaviour account of communication was historically opposed by those who adhered to a strict structural framework of communication and language. However, these early critiques (for a complete critique of Skinner’s analysis see Chomsky (1959)) are now understood to be based on miscommunication so are unsubstantiated (Palmer, 2006). Critiques of structural approaches to communication from those adhering to functional frameworks, include criticism that the evidence used to support biological perspectives is merely logical, but not empirical (Palmer, 2000, 2006). The prospect of environmental contingencies controlling communicative interactions is not usually considered within psycholinguistic frameworks, and critics have argued that presenting a structural conceptualisation of communication skills in terms of language structure may be misleading in the analyses of these communicative behaviours because it may conceal the environment-

behaviour relationships potentially controlling the communicative acts (Pierce & Cheney, 2017).

The two disciplines can also utilise prompt strategies (including modelling) and vocabulary, in fundamentally different ways (Bondy, 2019; Horton, 2020; LeBlanc et al., 2006; Tincani et al., 2020). Core vocabulary is a collection of the most frequently used words uttered by typically developing pre-schoolers, where a small set of words made up the majority of the naturally occurring speech recorded (Banajee, Dicarlo, & Buras Stricklin, 2003). Psycholinguistic frameworks might include reference to learners making requests (rather than mands), describe use of expressive labels rather than tacts, and answering questions rather than intraverbal functions (LeBlanc et al., 2006) (p. 51). The skills of asking and answering questions from verbal behaviour and linguistic frameworks are categorised differently, thus these two skills may be taught differently or similarly dependent on the underlying theory of communication employed. Within a verbal behaviour approach the skill of responding to the question, *what do you want?* would be functionally assessed (and taught) differently to the skill of asking for a pen. Within a linguistic framework, asking and answering questions may be viewed as expressive or receptive representations of the same skill (LeBlanc et al., 2006) so may instead be assessed and taught similarly. The two disciplines can also vary in their conceptualisations of terms, some examples are spontaneous communication (initiating versus responding), motivation, and defining what skills constitute a robust communicative repertoire. The psycholinguistic approach may fail to recognise fundamental functional communication deficits and communicative impairments in those individuals who have speech and a large vocabulary, but are unable to use these skills functionally.

Applications of Skinner's (1957) verbal behaviour approach to communication-based assessment and intervention for those with impaired functional communication skills have a

brief, but successful, history (Carr & Miguel, 2013; Pierce & Cheney, 2017; Sigafoos & Gevarter, 2019; Sundberg, 2016). Building on classic behavioural based previous works (Michael, 1982, 1993, 2000; Skinner, 1953, 1957), the established principles from applied behaviour analysis have been used to develop communication assessment and communication skill intervention procedures (Bondy & Frost, 2001; Frost & Bondy, 2002; Sundberg, 2014a, 2014b; Sundberg & Partington, 2013). The Verbal Behavior Milestones Assessment and Placement Programme (VB-MAPP) is one example of a verbal behaviour approach to communication skill assessment and teaching strategies. Guidance for educators to create communication skill goals that are relevant to the specific skill impairments assessed to include in learners' Individualised Education Programmes (IEP) are also provided (Sundberg, 2014b). Within a verbal behavioural approach, clinicians and researchers have successfully established improvements in the communicative abilities of individuals with developmental disabilities (Sigafoos & Gevarter, 2019; Sulzer-Azaroff, Hoffman, Horton, Bondy, & Frost, 2009; Sundberg & Michael, 2001). Despite successful behavioural works, and the development of evidence-based communication skills assessment and interventions that incorporate a verbal behaviour approach, behavioural approaches to communication interventions have not been widely employed (Tincani et al., 2020; Von Tetzchner, 2018). Trembath et al. (2019) recommended best practice using evidence-based approaches to optimise communication interventions that enable individuals with impaired communication skills to meaningfully partake in, and contribute to, all aspects of their lives. Functional accounts of communication skills can be seen as being more beneficial in understanding communication skill development with individuals who have impaired functional communication skills (Von Tetzchner, 2018). In light of this, investigations into functional communication skills and the verbal behaviour approach to assessing, teaching, and

identifying the challenges and barriers that may hinder learners' progress are on-going (Bondy, 2019; Sundberg, 2014b; Tincani et al., 2020).

But, as LeBlanc et al. (2006) noted, “these conceptual and terminology barriers are important but not insurmountable and the potential benefits of collaboration ... make it worthwhile to attempt to overcome these barriers” (p. 51). Several other authors agreed with the benefits of interdisciplinary collaboration to achieve the best possible outcomes for individuals experiencing communication difficulties (Cardon, 2017; Donaldson & Stahmer, 2014). While the goals for learners experiencing communication difficulties are the same, it is critical to continue to address the conceptual disagreements between psycholinguistic and verbal behavioural approaches because these underlying assumptions inform communication assessments and interventions. This is imperative, but particularly in regards to AAC systems which are commonly introduced as part communication interventions for those having difficulties acquiring or using natural speech to effectively communicate.

Augmentative and Alternative Communication (AAC) Interventions

In a bid to enable individuals with limited communication skill repertoires to exert some degree of control over their own environment and realise their full communication potential, researchers have developed various systems collectively known as Augmentative and Alternative Communication (AAC) (Beukelman et al., 2013; Ganz, 2015; Ganz, Rispoli, Mason, & Hong, 2014; Light, McNaughton, & Caron, 2019). The term AAC describes a range of systems and teaching strategies (Sigafoos & Gevarter, 2019) that are commonly employed in educational and clinical practice with those experiencing communication difficulties. AAC systems are designed to supplement (augment) or provide a substitute or replacement (alternative) to using speech as a mode of communication (Beukelman et al., 2013; Ganz, 2015). AAC systems can be unaided (no external tool required but physical motor control is, such as sign language) or aided (where an external tool is required, for

example an electronic device or set of pictures) (Beukelman et al., 2013; Bondy, 2019; Ganz et al., 2014).

Aided communication systems.

Aided AAC systems are further categorised into high-tech (using an electronic device and/or software) or low-tech systems (non-electronic such as picture and symbol based systems including the Picture Exchange Communication System (PECS) and communication boards) (Sigafoos, O'Reilly, Lancioni, & Sutherland, 2014; The American Speech-Language-Hearing Association, n.d.). The design and teaching strategies of some aided systems (high and low-tech systems) are predicated on evidence from linguistic assessment of core vocabulary (Beukelman et al., 2013; Horton, 2020; Laubscher & Light, 2020; The American Speech-Language-Hearing Association, n.d.). Consequently, some aided systems have a set of pictures that represent words based on this core vocabulary, and may have an additional set of pictures (known as fringe words) that are customised to suit individual users (Beukelman et al., 2013; Horton, 2020; Laubscher & Light, 2020; The American Speech-Language-Hearing Association, n.d.). Some high-and low-tech aided communication systems do not have systematic teaching protocols to support their use (Tager-Flusberg & Kasari, 2013). Various systems tend to include both structural based methods (such as augmented input through modelling the use of the aided system) and/or behavioural techniques (such as time delay and incidental teaching) (Bell, 2020; The American Speech-Language-Hearing Association, n.d.).

Speech generating devices

High-tech aided AAC systems that utilise an electronic device and/or software are collectively referred to as speech generating devices (SGD) within the AAC field (previously called voice output communication aids (VOCA) (Beukelman et al., 2013; Bondy, 2019). The invention of the iPad® and the subsequent range of communication based applications, has

accelerated and advanced speech generating technology (Bondy, 2019; Ganz et al., 2017; Light, McNaughton, & Caron, 2019) making them increasingly popular, and preferred, by users in educational and clinical settings (Aydin & Diken, 2020; McNaughton & Light, 2013; Morin et al., 2018). Some speech generating devices utilise iPads® and iPods® and use applications, such as LAMP Words for Life® (Language Acquisition through Motor Planning, n.d.), that are based on psycholinguistics and use core vocabulary and fringe words (Aydin & Diken, 2020; The American Speech-Language-Hearing Association, n.d.). Some speech generating devices have been found to be effective, and evidence-based, in replacing speech with some individuals (Aydin & Diken, 2020; Ganz et al., 2017; Lorah & Parnell, 2017; Morin et al., 2018; Muharib & Alzrayer, 2018).

Communication boards

Communication boards are a low-tech picture based AAC systems where users are taught to point to pictures on the board to replace or augment speech in order to communicate, and teaching strategies are often psycholinguistic based (The American Speech-Language-Hearing Association, n.d.). Communication boards typically have a set of pictures that represent words based on core vocabulary arranged on one board, and may have an additional set of pictures (fringe words that are customised to suit users' interests and preferred items) attached to the main board (Beukelman et al., 2013; Horton, 2020; Laubscher & Light, 2020). Communication boards are usually small in size making them portable, but can also be large wall size core boards with a set of pictures representing core words only that remains in the classroom (Devin & Pawlowski, 2018; Pearce, 2017).

The Picture Exchange Communication System (PECS)

The picture exchange communication system (PECS) (Bondy & Frost, 2001; Frost & Bondy, 2002) is one effective low-tech AAC system with evidence from more than 150 published papers demonstrating increased verbal behaviour and decreased challenging

behaviours (Pyramid Educational Consultants, n.d.-a). PECS and the associated teaching protocols are based on verbal behavioural and functional accounts of communication (Frost & Bondy, 2002) and have been found effective in educational settings (Ganz, Davis, Lund, Goodwyn, & Simpson, 2012; Ganz et al., 2014) and as evidence-based practice (Gilroy, McCleery, & Leader, 2017; Odom, Collet-Klingenberg, Rogers, Hatton, & Hatton, 2010; Wong et al., 2015). PECS is a low-tech pictorial based aided system, as well as a systematic set of teaching protocols, based on the analysis of verbal behaviour by Skinner (1957) and behaviour analytical learning strategies (Frost & Bondy, 2002). Learners are systematically taught across six separate phases to discriminate between pictures and to communicate with others by exchanging relevant pictures in a way that is accurately and easily understood by untrained communication partners (Bondy & Frost, 2001; Frost & Bondy, 2002). PECS and the systematic teaching strategies are focused on communication function, and each of the basic verbal operants are taught separately including teaching students to initiate communicative exchanges (that an interaction is required) that begins at the first phase and generalisation of skills across settings and communication partners. PECS and the associated Pyramid approach to education (Frost & Bondy, 2002; Pyramid Educational Consultants, n.d.-b) recommend methods to contrive or sabotage the communication environment to facilitate spontaneously produced initiation skills. Communication partners are encouraged to create opportunities for students to initiate communication by manipulating the environment, and suggested methods include withholding an item, providing an item that requires assistance, and waiting without providing prompts. Prompts are used as a teaching strategy within the PECS protocols, but to avoid students becoming dependent on prompts to communicate, the inclusion of specific prompt fading procedures is also employed. PECS has been demonstrated to increase verbal behaviour, support (not inhibit) the development of speech, and has been evidenced as providing individual with communication skills that are

functionally equivalent communicative replacements for challenging behaviours (Hart & Banda, 2010; Schlosser & Wendt, 2008). PECS is widely applied in schools in the United States of America and internationally (Pyramid Educational Consultants, n.d.-b; Tager-Flusberg & Kasari, 2013).

New Zealand Context

In New Zealand, individuals with disabilities (including communication difficulties) that are classified as high needs, are eligible for government funding provided by the Ministry of Education's Ongoing Resourcing Scheme (ORS) to provide a range of specialised services to support their additional learning needs until leaving high school (New Zealand Ministry of Education, 2020b). Students with disabilities are also eligible for an individual education plan (IEP) that sets out the learning goals (including any communication goals) for the student at school, including how and when the goals will be achieved, and who will assist the student to reach the goals (New Zealand Ministry of Education, 2020a). For students with experiencing communication difficulties, a speech language therapist (SLT) may be provided and for some students' with impairment severe enough to warrant additional specialised support can refer students for AAC system assessment (New Zealand Ministry of Education, 2019). While the exact number of individuals in New Zealand who may benefit from communication interventions and AAC systems is unknown, the survey conducted by Sutherland et al. (2014) found that almost 30% of adult participants living in residential care facilities in New Zealand were contenders for AAC system intervention. One specialised aided AAC system provider in New Zealand, The TalkLink Trust, listed their range of low and high-tech aided AAC systems as including core communication boards and speech generating devices (but not PECS) as options to assist their clients to communicate or control their environment (TalkLink, n.d.-a). In New Zealand, use of communication boards have been described as great tools for teachers to model to increase students' exposure to language

that is visible to benefit student with communication difficulties (Devin & Pawlowski, 2018). Communication boards are widely used as AAC systems in New Zealand schools (Pearce, 2017), but despite the common use of core boards their use has also been questioned in New Zealand (Andrews, 2016).

General AAC System Literature

A brief review of the AAC intervention literature revealed that despite the vast array of AAC systems, and advances particularly in high-tech AAC devices and applications, individuals with communication difficulties continue to encounter additional educational, social participation, and employment barriers and challenges, particularly as they reach adolescence and continue into adulthood (Ronski et al., 2015; Smith et al., 2020).

While increased provision of AAC systems is an initial step towards supporting individuals with communication skill needs, simply providing an aided communication system to individuals does not appear sufficient. For individuals who have been provided with an AAC system, it is essential that evidence is gathered of learners using communication skills functionally via the AAC system to ensure they are able to use their communication skills functionally within their everyday routines (Tager-Flusberg et al., 2017). Some evidence to date presented high-tech speech generating devices and some low-tech AAC systems (such as PECS) as having the potential to function as the primary mode of communication (Logan, Iacono, & Trembath, 2017; Tincani et al., 2020). Some have also concluded that speech generating devices and PECS were equally effective AAC systems (Aydin & Diken, 2020; Ganz et al., 2017). However, these findings may be misleading and should therefore be interpreted with caution, because AAC systems generally target different skills and are designed for varying communication impairments. For example, unaided systems such as sign language primarily target those who do not use speech often because of hearing loss. Some aided AAC systems are designed to replace or supplement speech as a

communication mode but not necessarily to teach or aid those with functional communication skill impairments (Bondy, 2019; Tager-Flusberg et al., 2017).

Recent reviews of studies with participants who were diagnosed with intellectual and developmental disabilities, established a preliminary evidence-base for use of aided AAC systems, but a consistent finding was that most participants were children (Aydin & Diken, 2020; Ganz et al., 2017; Holyfield, Drager, Kremkow, & Light, 2017; Logan et al., 2017; Morin et al., 2018; Parsons, Cordier, Munro, Joosten, & Speyer, 2017; Smith et al., 2020; Tager-Flusberg et al., 2017; Trembath et al., 2019). In their review of AAC interventions for adolescents and adults with ASD, Holyfield et al. (2017) found similar support for use of AAC systems to that found with children, but the authors noted some reservations due to the small number of participants ($N = 19$). It is unclear from the literature whether the evidence supporting children's (aged under 12 years) use of AAC systems can be generalised to adolescent and adult AAC system users (Morin et al., 2018). However, despite a clear gap in the evidence supporting the use of AAC systems in this population there is also no evidence to suggest that adolescents and adults will not benefit equally as well as the children studied (Bondy, 2019).

Another persistent finding within the literature was that studies tended to predominantly include request (mand) functions as the communicative outcomes (Alzrayer, Muharib, & Wood, 2020; Aydin & Diken, 2020; Ganz et al., 2017; Gilroy et al., 2017; Logan et al., 2017; Lorah & Parnell, 2017; Morin et al., 2018; Tincani et al., 2020). Other reviews found emerging evidence that some AAC systems may facilitate communicative exchanges that extend beyond request-based communicative interactions that have previously been found to dominate the research base (Logan et al., 2017; Tincani et al., 2020). However, it was also reported that few AAC system studies met all study design quality indicator standards largely due to lack of inclusion of generalisation, maintenance, and social validity data (Aydin &

Diken, 2020; Ganz et al., 2017; Logan et al., 2017; Morin et al., 2018; Muharib & Alzrayer, 2018).

A research-to-practice gap extensively noted was that individuals were typically taught to use AAC systems in decontextualised clinical settings and the use of communication skills, particularly those via AAC systems, were infrequently examined in real-life contexts (Ganz, 2015; Kent-Walsh & Binger, 2018; Light, McNaughton, Beukelman, et al., 2019; Morin et al., 2018; Muharib & Alzrayer, 2018; Smith et al., 2020; Tincani et al., 2020). AAC system studies tended to measure only the immediate effects, which presents an issue in terms of whether the communication skills acquired via AAC systems generalise across a range of natural routines and communication partners (Morin et al., 2018; Muharib & Alzrayer, 2018). The only exception was one review by Logan et al. (2017) where most of the studies examined were conducted in more natural settings, but the studies reviewed still overwhelmingly included trained researchers as interventionists as opposed to naturally occurring communication partners (such as teachers and caregivers). Muharib and Alzrayer (2018) suggested that implementing AAC systems in naturalistic contexts and everyday routines might better assist individuals to attain the targeted skills as well as aiding in making these skills more meaningful to the AAC system user. Examination of AAC system use with naturally occurring communication partners (including peers) within real-life contexts is urgently needed to aid in closing this research to practice gap (Anderson, Moore, Godfrey, & Fletcher-Finn, 2004; Ganz, Hong, Leuthold, & Yllades, 2019; Kent-Walsh & Binger, 2018; Muharib & Alzrayer, 2018; Smith et al., 2020).

Some studies sought to address this research to practice gap by observing communicative acts between students and their naturally occurring communication partners within their everyday school-based routines instead of clinical settings (Andzik, Chung, & Kranack, 2016; Carter, 2003a, 2003b; Chiang, 2008, 2009, 2009a; Chiang & Lin, 2008;

Chung, Carter, & Sisco, 2012; Chung, Douglas, Walker, & Wells, 2019; Drain & Engelhardt, 2013; Rehm & Bradley, 2006). Typical school based routines are important everyday educational and learning settings/contexts for students, and where students spend a large portion of their time. Two observational studies were conducted exclusively within mainstream educational settings (Chung et al., 2012; Chung et al., 2019), one exclusively within special education classes (Drain & Engelhardt, 2013), and the other across mainstream, special education, and non-academic educational settings (Andzik et al., 2016).

Much of the AAC system research to date has not evaluated the teaching strategies employed, or the specific components of different types of AAC systems that may have contributed to the efficacy found; only the AAC tools themselves used as communication modes have typically been included and evaluated (Aydin & Diken, 2020; Bondy, 2019; Morin et al., 2018; Muharib & Alzrayer, 2018; Ronski & Sevcik, 2018; Trembath, Iacono, Lyon, West, & Johnson, 2014). To successfully disseminate the AAC intervention evidence, requires to distinguish between the type of AAC system used, and the components of the teaching and implementation protocols used (Bondy, 2019; Ronski & Sevcik, 2018).

Some limited research (see Ganz, 2015) has found that often communication skills, especially the use of AAC systems, are not maintained because environments may not support their use (Andzik et al., 2016; Light & McNaughton, 2014). Therefore, although some AAC systems (such as the PECS and some high-tech devices) have been successfully taught to individuals with impaired communication skills, sometimes their long-term effectiveness may be limited as the environments do not support using AAC systems (Andzik et al., 2016; Jurgens, Anderson, & Moore, 2018). Instead, carers and others often compensate for the individual's difficulties by anticipating their needs or by setting up the environment in a way that renders communication unnecessary (Andzik et al., 2016), thereby reducing the need for any communication attempts (Andzik et al., 2016; Jurgens et al., 2018). In this way,

skills are lost. Further research and analyses of environments themselves, in terms of being facilitative or compensatory to learning and practicing functional communication skills is needed, and will be conducted as part of this research to contribute to communication and AAC intervention research in general.

Vital to describing students use communication skills functionally, and in keeping with a verbal behavioural interpretation, is capturing a number of variables. Therefore, a thorough description of communication skills should include: the rates of communicative interactions per hour, whether students responded or initiated, the communication modes used, the communication skills used via aided AAC systems when they were available, evidence of the four fundamental verbal operant units, and the generalisation of students' communication skills to natural communicative environs and communication partners.

The popularity and excitement over the latest innovations in high-tech aided AAC systems (devices and applications) as part of communication skill interventions has created a situation where, as Bondy (2019) described, the use of these devices is promoted as a “veritable panacea for this population” (p. 351). Many of these AAC system advancements have been made possible by the invention of the iPad® in 2010 (Apple Incorporated, 2010). In light of the overwhelming popularity of these high-tech AAC devices, prior observational studies conducted within naturalistic settings that included AAC systems and were published after the iPad® (focus of SGD rise in popularity), were searched. Only four studies were found that were conducted with participants with intellectual and developmental disabilities (Andzik et al., 2016; Chung et al., 2012; Chung et al., 2019; Drain & Engelhardt, 2013).

Drain and Engelhardt (2013) observed the communicative interactions ($n = 155$) between six children and adolescents (10-15 years), and their teachers. All participants had diagnoses of ASD and were described as having severe language impairments of less than five functional words. Participants were observed in person, for 30-minutes each, within their

special education classes in England. The focus of this study was to examine spontaneous communicative acts compared to evoked acts. In their study, Andzik et al. (2016) documented communicative acts ($n = 2179$) with 23 children (aged 6-12 years) who had disabilities (including ASD, multiple disabilities, intellectual disabilities, and acquired brain injuries). Participants were included in this study if their use of speech was insufficient to be reliably understood by an unfamiliar listener and they used aided AAC systems. Each participant was observed in person for an average of just over five hours, and observations were conducted within mainstream education (20.00%), special education (71.00%), and non-academic (9.00%) settings at an inclusive school in the United States of America.

Chung and associates (2012; 2019) conducted two studies. In the first study, Chung et al. (2012) observed the social interactions ($n = 1354$) of 16 children and adolescents (10-14 years) with diagnoses of ASD or intellectual disabilities, who used AAC systems, within structured mainstream educational classes in the United States of America. More recently, Chung et al. (2019) observed social interactions of high-school aged participants ($n = 10$) within mainstream classrooms in the United States of America. Participants (15-19 years) all had diagnoses of intellectual and developmental disabilities (IDD; including autism spectrum disorder) and either used AAC systems to communicate or had social and communication goals in their Individualised Education Programme (IEP). Observations in both studies were conducted in person, and participants were observed for approximately three hours each. Partial interval (1-minute) recording and time sampling procedures were used in both studies to detail the frequency of interactions, with whom they occurred, and the type of interactions (initiations or responses). A strength of the latter study (Chung et al., 2019) was that data for 10 peer comparisons (participant without disabilities of the same gender as the focus students with disabilities) were collected.

Some forms of antecedent conditions (but to varying degrees of detail and varying descriptions) were described in these four prior studies, but not all of these studies documented the consequences of the communicative acts observed. Two studies by (Chung et al., 2012; Chung et al., 2019) gave only brief descriptions related to settings and antecedent context such as instructional format, proximity of other people and/or AAC systems. Two studies (Andzik et al., 2016; Drain & Engelhardt, 2013) included more detailed descriptions of antecedent conditions (including prompts). The communication acts in the study by Andzik et al. (2016) were coded according to the antecedent conditions that occasioned them within three distinct categories, opportunities to respond, opportunities to initiate, or spontaneous initiations. One study (Drain & Engelhardt, 2013) used a four-level continuum model of communicative spontaneity (Carter & Hotchkis, 2002) to describe the antecedent conditions preceding communicative acts in detail (as opposed to a simple binary conceptualisation where communicative acts are evaluated as either initiated or not). Within this continuum model, one end of the spectrum is applied to communicative acts that are emitted with the least intrusive prompting (so are most spontaneously produced), and may include examples of communication acts that are occasioned by natural cues such as an object, activity, or communication partner present in the environment. Level two prompting refers to communicative acts that occur after communication partners manipulate the environment in order to highlight stimuli. Level three antecedent conditions are generalised communicative cues, or prompts that indicate a communicative response is expected but do not necessitate a specific response. Typical examples include communication partners asking questions such as *what do you want?* or presenting an aided AAC system, to indicate a communicative response is expected. Finally, level four prompts are the highest prompt level where direct physical or verbal prompts are delivered to evoke a specific communicative response. Direct prompts can include communication partners giving specific instructions to

communicate (such as *say pen*), providing physical assistance to sign or use an AAC system to communicate a specific response, or modelling the expected communicative response in the same form as the participant is required to reply (a communication partner models use of aided AAC system or manual sign). For further explanation and detail of the communicative spontaneity continuum model see Carter and Hotchkis (2002).

Two prior studies observed students participating in an average 51 (Drain & Engelhardt, 2013) and 19 per hour (Andzik et al., 2016) communicative acts per hour. The exact rates of communication acts were not reported in two studies (Chung et al., 2012; Chung et al., 2019), to enable some comparison with the rates found in other studies the reported proportion of 1-min interval intervals where communication acts were observed were used to generate estimated overall rates of communication acts for both these studies. Estimated average rates were calculated as approximately 68.50 (Chung et al., 2012) and 35 (Chung et al., 2019) acts per hour. In addition, Chung et al. (2019) observed fewer communication acts overall with students with disabilities when compared with their typically developing peer comparisons, and mean estimated rates found in this study were 30 acts per hour with students with disabilities and 40 per hour with typically developing peer comparisons.

All four studies reported the types of communication acts as prompted opportunities for students to respond or as acts initiated by students (Andzik et al., 2016; Chung et al., 2012; Chung et al., 2019; Drain & Engelhardt, 2013). The proportion of opportunities to respond that participants encountered in prior studies included 90% in Andzik et al. (2016) study, followed by 86% (Chung et al., 2012), and 60% of the total communication acts observed with participants in Drain and Engelhardt (2013). Mean rates of communication acts coded as opportunities to respond were reported at 17 acts per hour (Andzik et al., 2016) and 31 per hour (Drain & Engelhardt, 2013), but a Wilcoxon test showed no significant

differences between the rates of opportunities to respond and the rates of student initiated acts observed. The estimated average rate for response opportunities in Chung et al. (2012) was 60 acts per hour. Findings from Chung et al. (2019) revealed that students with disabilities and their peer comparisons were observed during similar proportions of opportunities to respond (approximately 38%) at the same estimated mean rate of 24 acts per hour. Both studies by Chung and colleagues (2012; 2019) included instructions that did not necessarily require a communicative response in their total communication acts. Student initiated communication acts were observed less frequently than acts that were opportunities for students to respond in all four studies (Andzik et al., 2016; Chung et al., 2012; Chung et al., 2019; Drain & Engelhardt, 2013). Acts initiated by students were observed at rates of 2.5 per hour (Andzik et al., 2016), and 21 per hour (Drain and Engelhardt (2013), but no significant difference was established with a Wilcoxon test). Estimated mean rates of initiations were 8.5 per hour (Chung et al., 2012), and were observed at approximately 11 per hour with focus students and at 20 per hour with peer comparison students. Some students were not observed initiating communication acts (Andzik et al., 2016; Chung et al., 2012). Andzik et al. (2016) was the only prior study found that included a dependent variable of opportunities to initiate to attempt to capture occurrences where communication partners had manipulated the environment to elicit a communicative response from participants and waited at least 5 seconds for participants' to produce a communicative act. However, some aspects of the definition used to define initiations were inconsistent with a verbal behavioural account. For example, an act where a communication partner stopped midway through a sentence to allow participants respond by completing the sentence was included as an initiation opportunity. Within a behavioural account, this type of communicative episode would instead be coded as an opportunity to respond. During the entire study, no communication partners were observed to contrive opportunities for participants to initiate the communicative exchange. The authors

noted some potential initiation opportunities were anecdotally observed but were missing the necessary wait of at least 5-seconds after the environmental sabotage attempt occurred (Andzik et al., 2016). Results from observations with students in the research by Chung and others (2019) study revealed both similarities and differences between participants and their peer comparisons, in the frequency and type of interactions. Although fewer communication acts in total were observed with focus students, a similar patterns of ratio of student responses and initiations between some focus students and their peer comparisons was found (Chung et al., 2019). Five focus students, and seven peer comparison participants, were observed during a larger proportion of acts coded as opportunities for students to respond than during acts they were observed initiating, and some students with disabilities initiated more than their peer comparisons.

The type of communication mode used is irrelevant in regards to the function of individuals' communication skills. A communication mode of some sort is necessary to enable an exchange, and the mode used should be able to be understood by others. Prior studies described the communication modes used by students (Andzik et al., 2016; Chung et al., 2012; Chung et al., 2019; Drain & Engelhardt, 2013), and some (Chung et al., 2012, Andzik et al., 2016) also documented students' use of AAC systems (aided and unaided) including PECS in one study (Drain & Engelhardt, 2013). All participants in Andzik and others (2016) study had AAC systems, but this was not true for any other study. In a study by Drain and Engelhardt (2013), the communication modes used by participants were coded as 20% verbal (vocalised sounds including echoic), 63% physical (for example, sign language and gestures), 10% use of PECS, and 15% modelling (participants imitated partners' prompt). Challenging behaviours and other were rarely observed so were removed from analyses. Participants in this study infrequently used PECS, but the use of PECS was observed significantly more often with spontaneous communicative acts compared to those that were

evoked. Andzik and colleagues (2016) observed students primarily using aided AAC systems ($M = 65\%$), followed by speech ($M = 20\%$), gestures and sign language ($M = 19\%$), and hand-to-hand physical prompting in an average of 6.5% of total communication acts observed. In Chung and colleagues (2012) studies, students were most often observed using facial expressions ($M = 41\%$), gestures ($M = 34\%$), vocalisations ($M = 22\%$), speech ($M = 16\%$), and modes coded as other ($M = 5\%$). Use of AAC systems was minimal, with high-tech ($M = 13\%$) and low-tech ($M = 5\%$) used most often, whereas manual sign ($M = 4\%$) was infrequently used. Participants in Chung and associates (2012) often used multiple communication modes during the same interaction; a mean of 1.40 modes per communication act was reported. In their second study, Chung and colleagues (2019) found communication mode followed the same pattern of frequency of use for participants and their peer comparisons, who most often interacted using speech ($M = 29\%$ and 44% respectively), facial expressions ($M = 16\%$ and 23%), gestures (including sign language) ($M = 13\%$ and 20%), but vocalisations ($M = 1\%$ and 0.60%) were less frequently used. In both studies by Chung and colleagues (2012; 2019), instructions that did not necessarily require a communicative response from students were counted as communication acts and included in their results.

Participants did not respond to more than half ($n = 1090$, 55.00%) of the response opportunities provided by communication partners in Andzik and colleagues (2016) study, and further prompting still resulted in no response from participants in 42.00% of instances. Andzik and others (2016) suggested instances of students not responding might have been due to lack of access to aided AAC systems, or when an aided system was available many participants were not given a chance to generate a response. The authors noted anecdotal evidence of communication partners who interrupted, rapidly repeated the same question, or changed the topic. Students in Chung and associates' (2012) investigation did not respond

during approximately 55% of the total acts observed, and during 38% of acts observed by Drain and Engelhardt (2013) no response from the students was observed.

Two studies recorded students' access to aided AAC systems as a proportion of communicative acts observed (Andzik et al., 2016; Chung et al., 2012). On average students had access during less than half of the communication acts observed (42% in Chung et al. (2012)) but during more than half ($M = 61\%$) of the acts observed Andzik et al. (2016) study an aided system was available. In addition, more access to high-tech speech-generating devices ($M = 63\%$) than low-tech systems ($M = 27\%$) was observed (Andzik et al., 2016). Three students in both Andzik et al. (2016) and Chung et al. (2012) studies were never observed with an aided system available, and Andzik and others (2016) further reported that an aided system was not within students' reach during 46% of their total opportunities to respond nor during 15% of all observed student initiations. Although Drain and Engelhardt (2013) did not specifically record access to aided systems, some students in their study were reported as using an aided system (PECS) so at least some access to this aided systems was available to these students. Some authors suggested possible explanations for the limited use of AAC systems found in their studies, as maybe resulting from aided systems being relatively unavailable (Andzik et al., 2016; Chung et al., 2012). Authors in one study (Chung et al., 2012) suggested that students low use of aided AAC systems indicated participants had shown preference for unaided AAC systems (such as the high proportion of facial expressions and gestures observed). Andzik et al. (2016) suggested a reason for lack of AAC device use observed may be because participants were not given a chance to respond (and cited anecdotal evidence of staff rapidly repeating questions) or that formulating communicative responses (especially via AAC devices) takes time to do. Only one previous study (Andzik et al., 2016) included rates of communicative acts via AAC systems and found

speech-generating devices were used on average during 2 communication acts per hour, and low-tech and single-message devices during just over one act per hour.

When searching for inclusion of function in prior observational studies, only two prior studies assigned a functional code to the communication acts they observed (Chung et al., 2012; Drain & Engelhardt, 2013). Communication functions of student initiations in one study (Drain & Engelhardt, 2013) were coded as *requests* (almost three quarters), while *other* (18%) and *reject* (6%) were least frequently assigned to student initiations, and significantly more communication acts coded as *requests* were observed in comparison to other functions. In contrast, communication acts that were opportunities for students to respond were most often coded with functions of *other* (61%) or with codes of *reject* (20%) or *request* (10%) (Drain & Engelhardt, 2013). Chung and others (2012) reported uniquely coded functions dependent of whether the communication act was a student response or initiation, this separate coding of function is reflective of the expressive and receptive roles of speaker and listener typically adopted within structural accounts of communication function. The function assigned to student initiated interactions were most frequently coded as expressing wants and needs ($M = 38.90\%$), social closeness ($M = 28.30\%$), transferring information ($M = 9.20\%$), and fulfilling social etiquette ($M = 7.10\%$). The authors' did not assign a function to some interactions (15.80%) due to being unable to hear the conversation. When communication partners provided opportunities for students to respond, the functional codes most frequently assigned were instead to provide instructions ($M = 57.00\%$), comments ($M = 28.20\%$), or to ask questions that were closed-ended ($M = 10.60\%$) or open-ended ($M = 1.90\%$), or unclear ($M = 1.40\%$) or other ($M = 0.70\%$) (Chung et al., 2012).

To whom students communicate with is an important aspect to document in order to address the use of communication skills functionally. The proportion of adult versus peers during communication acts previously observed showed that student predominantly

communicated with adults, specifically special education staff. All communication acts in one study occurred with adults (teachers or teaching assistants) and no participants were observed communicating with peers. In two studies (Andzik, Schaefer, Nichols, & Chung, 2018; Chung et al., 2012), communication partners were adults during 90% or more communication acts, and three participants were never observed initiating towards a peer (Andzik et al., 2016). The proportion of communication acts with adults was much lower for both students with disabilities and the peer comparison students observed in Chung et al. (2019). Although participants with disabilities were observed partaking in fewer interactions than their peer comparisons' overall, inclusion of peer comparison data in Chung et al. (2019) revealed some interesting findings. Five participants with disabilities interacted with peers, and three participants interacted with mainstream educators, more often than their peer comparisons. Seven peer comparison students' responded more frequently than they initiated towards peers, a pattern similar to five participants with disabilities. Higher frequencies of communicative acts between students with disabilities and peers was correlated with less adult proximity, specifically the presence of support personnel (Chung et al., 2019) and similar findings indicated that the presence of teacher aides served as barriers to interactions with typically developing peers (Anderson et al., 2004). The authors of Chung et al. (2012) suggested that adults tending to dominate interactions, and participants playing more passive roles, might be a result of communication partners' expectation of participants' inability to respond.

A complete description of communicative episodes in keeping with a verbal behavioural approach must also include descriptions of the behaviours of communication partners. Specifically, the prompts and consequences communication partners provide to students. Prompt descriptions were not included in either study by Chung and colleagues (2012; 2019), both studies only made note of whether communication acts were initiated or if

they were student responses. As noted earlier, (Drain & Engelhardt, 2013) did include details of prompts and prompt types using a continuum model and a Friedman test revealed a significant difference in use of direct prompts (communication acts that were prompted at the highest level). Only Andzik et al. (2016) included additional prompting by the communication partner and found that staff provided additional prompts for students to communicate during approximately 45% of all acts. Overall, participants received an average of 3.17 (range 1-25) additional prompts following the initial opportunity to respond provided (Andzik et al., 2016).

Within a verbal behavioural account of the effectiveness and functionality of students' communication skills, the responses (consequences) provided by communication partners ought to be included and should include no responses. Although both studies by Chung and others (2012; 2019) reported if communication partners offered a response or not, no further details related to communication partner responses. Only two studies (Andzik et al., 2016; Drain & Engelhardt, 2013) included some descriptors of the consequences provided by the communication partners. Andzik and colleagues (2016) described responses by staff following communication acts coded as both response opportunities and student initiations, and found most observed responses were *attention* ($M = 63\%$) or *tangible access* ($M = 15\%$), whereas *correction* ($M = 8\%$) or *escape* ($M = 1\%$) were less frequently observed. One prior study (Drain & Engelhardt, 2013) recorded both functions and consequences, and reported that consequences following student initiations were most often *no response* from the teacher ($M = 40\%$) and *delivered* ($M = 39\%$) in similar proportions, followed by *denied* ($M = 18\%$) and *acknowledging* ($M = 15\%$). Drain and Engelhardt (2013) analysis of communication partner responses revealed no significant differences between initiated and evoked (response opportunities) acts that received the consequence of *no response*. The most common consequences following spontaneous acts were *deny* and *delivered*, whereas evoked acts were

more likely to be followed by consequences of *acknowledge*. Finally, results from Chung and associates (2012; 2019) indicated that communication partners were not observed providing a response to students. Chung and others (2012) noted that of the total interactions students initiated towards their teachers observed, a mean of just over 1% were described as not reciprocal. In contrast, communication partners were not observed providing a response to approximately 40% of students' communicative attempts but also found no significant difference between opportunities to respond or student initiated acts in whether no responses were the observed consequences (Drain & Engelhardt, 2013). Preceding authors suggested strategies to facilitate and improve learners' spontaneous communication skill development, such as making objects inaccessible (which was referred to as "the mand technique" (Drain & Engelhardt, p. 7). Drain and Engelhardt (2013) explained that the mand technique was often used with young children but not school-aged children, and claimed that the strategy may not be appropriate for those who are school-aged but did not specify a reason for why it was assumed inappropriate for older children. The same authors noted that further work was needed to determine the effect of no responses by communication partners, and the provision of consistent responses, on communication skill development (Drain). Authors of another past study concluded that developing initiation skills as young children is essential in preparing individuals to become self-advocates in the future (Andzik et al., 2016).

In summary, these four observational studies (Andzik et al., 2016; Chung et al., 2012; Chung et al., 2019; Drain & Engelhardt, 2013) provided some empirical data to describe the nature and extent of students' functional communication skills. However, the coding and categories used to describe these variables were not consistent with a verbal behaviour account of communication skills, so some limitations from a verbal behaviour perspective remain. Most of the prior observational studies appear to have used psycholinguistic (typically distinguished as expressive or receptive communication) frameworks that produced

an eclectic mix of descriptions of students' communication skills, and were predominantly conducted within mainstream schools in the United States of America (Andzik et al., 2016; Chung et al., 2012; Chung et al., 2019), with the exception of one which was conducted within special education school in England (Drain & Engelhardt, 2013). None of the previous studies included here have described the communicative interactions observed using Skinner's verbal operants. As Tincani et al. (2020) noted very few studies have examined communicative behaviours from a verbal behavioural approach in general.

Overall, these four descriptive studies all provided an eclectic mix of dependent variables to describe the communication behaviours observed, and somewhat describe the provision of prompts and responses provided by communication partners, leaving limitations. The use of variations in codes applied in prior studies to measure the observed communication acts provided insufficient information on the majority of the communicative acts to evaluate their effectiveness to the participants. In terms of the spontaneity of the participant's communicative acts, these findings provide frequency and levels of prompting observed in the sample population, but without a normative comparison of typically developing individuals' communicative behaviours it is difficult to determine if the levels of spontaneity vary from that of typically developing peers.

To adequately describe communicative episodes from a verbal behaviour perspective, details related to the antecedent conditions that occasion the behaviour, the students' communicative behaviour itself, and the consequences (responses) provided by communication partners have not yet been comprehensively been addressed by previous investigators, and certainly not within a behavioural account (to the best of the authors knowledge). Due to the complexity and disagreement as to how to categorise communicative behaviours (Ronski & Sevcik, 2018; Tager-Flusberg & Kasari, 2013; Tager-Flusberg et al., 2017), communication skills in the present investigation will be coded to align with applied

verbal behaviour analysis. From a functional and behavioural perspective, a significant limitation of previous descriptions of communication environments as facilitative or compensatory within the communication skill research remains unaddressed.

As Light, McNaughton, Beukelman, et al. (2019) noted “This work is urgent. Further time must not be lost in the lives of children and adults who require AAC [systems]” (p. 10).

To address these limitations, this study was designed to add to the current literature by providing a unique description of communication skills observed as verbal operants from a behavioural perspective. The overarching aim of this study was to determine the nature and extent of the naturally occurring communicative episodes observed with students who have previously been taught to use an AAC system within a New Zealand special education high school, from a verbal behavioural perspective. In order to assess to what extent the environments facilitated the development and practice of functional communication skills, several research questions within two integral meta-questions were posed:

- 1) What evidence is there that students use communication skills functionally?
 - a) How many communicative episodes occur per hour?
 - b)
 - i. What proportion of communicative episodes do students initiate?
 - ii. What proportion of communicative episodes are opportunities for students to initiate?
 - iii. What proportion of communicative episodes are opportunities for students to respond?
 - c)
 - i. What communication modes do students use?
 - ii. Are aided AAC systems available to students during observation sessions?
 - iii. Do students communicate more frequently when aided AAC systems are available?

- d) What proportion of students' communicative episodes show evidence of any of the four primary verbal operants?
 - e) What proportion of students' communicative episodes involve adults and what proportion involve peers?
- 2) What evidence is there that staff prompted students to communicate and to what extent can staff responses to student initiations be described as functionally appropriate matches to student initiations?
- a) How frequently are prompts delivered by staff, and what type of prompts are used, to elicit communicative responses from students?
 - b) To what extent can staff responses to student initiations be described as functionally appropriate matches?

Method

Participants and Settings

Three female young adults partook as Group 1 participants ($M_{age} = 18.03$ years, range = 16-20 years) they will now be referred to as student participants. Student participants were Bella (20-years, 3-months old), Deedee (17-years, 7-months old), and Sophie (16-years, 1-month old) (all participant names are pseudonyms). Bella, Deedee, and Sophie were all enrolled in the same Special Education Unit (SEU), a separate specialised educational facility attached to a mainstream New Zealand high school where students aged 13-21 years were eligible to attend. Individuals were included as student participants if they met the following inclusion requirements: a) were individuals aged 13 years or older and enrolled in a special education school b) had previous experience with an Augmentative or Alternative Communication (AAC) system or device c) and had communication skill goal(s) in their Individualised Education Programme (IEP) irrespective of diagnoses. Standardised assessments of students' communication skills, adaptive behaviours, or specific disability or diagnoses were not recorded as part of this study, but all three students qualified for New Zealand Ministry of Education government assistance for students with high support needs and met the criteria to have an IEP.

At the time observations were conducted for this study, Deedee and Sophie were in receipt of regular and ongoing specialised speech and language services, which included support specific to their aided AAC system needs via TalkLink Trust New Zealand (TalkLink, n.d.-c). TalkLink provided AAC system training and tools to students and staff. IEP notes indicated that two aided AAC systems and training had been recently (less than one year) introduced for Deedee and Sophie. The teaching strategies employed for both systems were based on the Language Acquisition through Motor Planning (LAMP) approach to teaching independent and spontaneous communication skills and included direction for adults

to assist learners by modelling the use of aided AAC systems (Bell, 2020; Language Acquisition through Motor Planning, 2020). Students' most recent IEP goals, at the time of this study, were as follows.

Bella's latest IEP contained a goal for her to use sign language to augment her communication skills and reference to Bella tending to use loud vocals and assume an authoritarian role in conversations.

In Deedee's most recent IEP, communication skills were documented in several sections. Deedee was noted as "interacting well with mainstream students", and her use of vocals were noted as "vocalising more spontaneously and using less sign", "talking a lot [so] doesn't need signing [because her] language improved", able to vocally label nouns, and able to recite her personal details. Deedee's use of aided AAC systems was documented in her IEP as "using [the] core board and will scan board or fringe for picture". Goals specific to Deedee's communication skills were to maintain vocalisations of personal details and labelling nouns. Strategies to achieve these goals were for staff to "model name and say letters [then] remove model and [Deedee will] do again". Deedee was noted as being "very adult prompt dependent".

Sophie's most recent IEP contained extensive reference to communication skills. Sophie was described as being able to vocalise "a number of words – please and thank you especially around food" and that she would "sometimes imitate a sound". Sophie was also described as often making the sound 's' or 'b' and saying the words 'bubbles'; 'bee'; 'yeth (yes)', and that when Sophie is offered food she was answering 'pls'. Communication skill goals specific to use of vocals were for Sophie "to attempt to imitate given sounds back to an adult" and "imitate sounds through music", and for Sophie to "experience a variety of sensory stimulation to develop spontaneous verbalisation". Related to aided AAC systems it was noted that communication boards were incorporated into communications with Sophie,

and that Sophie wore her core board. Sophie was described as “beginning to use [the] core board fringe [words] to help identify when she is sad” and that she could use the high-tech AAC device by pointing at the yes and no pictures “to indicate she wants something”. Goals for Sophie specific to use of aided AAC systems were to “develop conversation through the use of a core board” and to use the core board to “answer questions 50% of the time”.

Strategies staff were instructed to employ were to model core board use with Sophie so she “will be encouraged to use core board” and to “acknowledge any attempt [Sophie] may make with the core board”. Communication skills goals specific to sign language were for Sophie to “maintain all 16 [manual] signs”, that with support [Sophie] will copy signs”, “when asked a question [Sophie] will respond with a sign”, and that using her signs [Sophie] will respond to yes no questions”. Strategies were specified for staff to encourage Sophie to “answer questions with a yes no [manual] sign, which is more spontaneous”. General communication skills goals were that “with support [Sophie] will learn to request (initiate)” and for Sophie to “tolerate sensory activities” in purpose built room at the school “to encourage spontaneous verbalisation”.

Individuals were included as Group 2, now referred to as staff participants, if they met the inclusion criteria of being a special education teacher, teacher aide, or other support personnel currently working with at least one of the student participants within their special education facility to support them during their typical school routines. Staff participants were three female special education teachers and teacher aides who had worked within the SEU facility for a period of more than two years and met the inclusion criteria for being a staff participant. No participants were remunerated for their participation.

Observations took place within three settings: special education classroom academic-based setting (SE), community-based settings (CM), or non-academic settings (NA). All academic observations were conducted within the same classroom and all three students were

members of the same SEU classroom and were the only students allocated to this particular classroom during this study. During observations within the special education classroom all students along with at least one staff participant were typically present and a large wall size core board was present in the SEU classroom during all observations. Non-academic observations took place during activities conducted outside of the special education classroom but still within the school campus (for example, in communal areas of the mainstream school, playgrounds, meal areas, and the SEU kitchen and hallways), and included transitions between activities or spaces. Community-based observations were conducted within settings offsite from the school campus but during activities that were part of the students' regular school routines. Community settings included public libraries and swimming pools, horse-riding lessons for people with disabilities, shopping malls and food courts, and restaurants. During non-academic and community observations, peers and staff from other special education and/or mainstream classes were often present. At least one staff participant (and up to three at any one time) were present during all special education classroom observations. In all settings, at least one staff member (either a staff participant or other SEU staff member) was present during all observations, which meant the researcher was never alone with student participants.

Dependent Variables

Communicative episodes (CE) were the primary dependent variable. Communicative episodes were operationally defined as verbal behaviours directed towards another person. Specifically, participants attended to, approached, or persisted with a specific communication partner which included instances of looking at a communication partner, gesturing towards a communication partner, gaining a communication partner's attention by using their name, or physically touching or pointing to the communication partner.

Data describing the observed communicative episode and the communicative environment (antecedents and consequences) in accordance with a functional verbal behavioural account of communication were detailed under three mutually exclusive communicative episode types: Opportunity to Respond (OR), Opportunity to Initiate (OI), or a Student Initiation (SI). An *opportunity to respond* was counted when a student encountered a chance to produce a verbal response, where a communicative response would be expected. Opportunities to respond included instances where: a) a student was asked a question or someone stopped speaking mid-way through a sentence, and a response from the student was expected. Examples of opportunities to respond included: a) If a student was asked *would you like a pen?*, or while a student was holding a pen, they were asked *you are holding a...?*, b) If a student was instructed to produce a communicative response (for example, was instructed to *please use your words* or to *use your device to say yes* or communication partners pointed to an aided AAC system), c) If a student was greeted (for example, someone said *good morning* or waved to a student) or they experienced a gesture (for example, offer of a high-five or wave). Verbal behaviours directed towards students that did not require a communicative response were not recorded as part of this study. These included comments like *you have chosen a blue pen*, compliments received (for example, *I like your pen*), instructions such as *go and get a pen*, and other phrases like *please point to the blue pen*.

An *opportunity to initiate* was recorded when a student experienced a purposefully sabotaged communicative environment, in the absence of a prompt to communicate for at least five seconds following the sabotage attempt, and the student emitted an un-prompted communicative response. Examples of environmental sabotage included instances where the students' access to a highly preferred item was purposefully restricted, or if an item vital to a task was deliberately placed out of the student's reach, or the student was provided with an item or activity that required assistance from the communication partner.

The final communicative episode type was a *student initiation (SI)*, or instances where a student emitted unprompted verbal behaviour (in any mode) that was directed towards another person. Examples of student initiations included, if a student requested *I want a pen* vocally, via manual sign or by pointing to an aided AAC system, when a pen was required but in the absence of a prompt to make this request.

Communicative episodes were counted as separate and discrete episodes when separated by at least five seconds or when a student experienced initiated another communicative episode. If more than one opportunity to respond occurred with the same student, but without at least a five-second gap between each opportunity to respond, this was recorded as only one communicative episode.

For every communicative episode that occurred, the observer(s) recorded additional descriptive data under the following headings (these categories were not mutually exclusive):

- a) Communication partner: Who the communicative episode included (the person the student directed their verbal behaviour towards). Categories used were: Staff participants (G2), special education peers (P), other peers (OP) such as a mainstream students or visitors of similar age, or other adults (OA) that were not staff participants such as other special education staff members, visiting professionals, mainstream staff members, or adult visitors onsite.
- b) The communication modes used by students were coded as vocalisations (V) (including intelligible words, approximations, or sounding out letters that were understood by the observer), gesture (G), sign language (SL), use of a high-tech AAC device (HT), or use of a low-tech AAC system (LT). Unwanted (UW) mode was recorded for instances of communicatively inappropriate behaviours that were initiated by students or were student responses that occurred within five seconds following an opportunity to respond. Examples of unwanted modes included:

crying, squealing, leaving the room to escape a task, self-injury, physical harm to others, property damage, or stereotypical behaviours. To measure the extent to which students responded to opportunities to respond, if students did not produce any of these behaviours in any mode, no response (NR) was recorded. For students who used multiple modes during a single communicative episode, all modes were recorded.

- c) The communicative function of students' verbal behaviours were defined in accordance with Skinner's (1957) verbal operants and were categorised based on his definitions of the four fundamental types of verbal operants: Mand (M), Tact (T), Intraverbal (IV), and Echoic (E). Functional codes were defined as: mand (requesting), intraverbal (responding to verbal behaviour of others), tacts (naming), and echoic (imitation of another person's verbal behaviour, including imitation of an AAC system). In instances where communicative episodes were impure (multiply controlled), all functions of the communicative episode were coded. If a student made a request, but did not specify the desired outcome (reinforcer), the episode was coded as a mand despite being a partial mand. For example, if a student vocalised *please* or an approximation of the word *please* in a bid to obtain access to a pen, but did not specify that a pen was being requested, this was coded as a partial mand.
- d) Access to aided AAC system: The availability of aided AAC systems was captured as students having the system within reach (IR), in their location (IL) (room they were in or within sight, but not within reach), or as no AAC system available to the student (No AAC). When aided systems were available, the specific type (high or low-tech) was noted.

- e) If a staff participant delivered additional prompts within five seconds of an initial opportunity to respond, these prompts were recorded as having occurred (P) and the number of any additional prompts delivered during the same episode were counted, or no additional prompt (NP) was instead coded. When prompts occurred, the type of prompting was coded as being vocal (V), physical (P), an aided AAC system model (AACM), or an aided AAC non-model (AACNM), or gestural (G). Prompts coded as aided AAC system model were defined as instances where staff operated an aided system themselves to provide a model of the students' target behaviour (AAC model). Instances where staff operated an aided system themselves to demonstrate their own communication using the aided system (but did not provide a model of the student's target behaviour) were instead coded as AAC non-model prompts. If a communicative episode occurred with one or more additional prompts, but without a five-second gap between the initial communicative episode and subsequent prompts, then one communicative episode was recorded and the number of additional prompts were tallied. If an AAC system prompt was provided, then this was counted as one prompt regardless of how many pictures or icons were selected, but if a different AAC system prompt was delivered then two additional prompts were scored.
- f) Consequence of communicative episodes: For communicative episodes observed with staff participants, their responses (consequences) were documented. The communication partner response, or other change in stimuli, that occurred immediately (within at least five-seconds) following the communicative episode was recorded as a consequence. Consequences were coded as: no response (NR), or staff responded with attention or praise (AP), correction (CR), reprimand (RP), compliance (CM), tangible access (TA), help, information, or assistance provided

(HA), or escape from task or activity (EA). If more than one consequence followed a communicative episode, all consequences were recorded. Correction was defined as a response that contained information to advise students how they might correctly approach a task or problem, to teach a correct response by stating the desired answer, or to provide students with a strategy. For example, if a staff participant stated *use your quiet voice, can you say pen instead* or *please take the pen out of your mouth*. Reprimands were defined as staff responses to express disapproval of students' behaviour but with no correction strategy provided. For example, staff saying *that is incorrect*. A response that was by definition a correction (the expected behaviour or strategy was specified) but also included aspects of reprimand (disapproval of behaviour), was still coded as a correction. An example of this situation might include if a staff participant said *take the pen out of your mouth* (which is specifying the expected behaviour or a strategy for the student to remove the pen from their mouth) but could also be indicative of the staff participant's disapproval of the student having a pen in their mouth, this was still coded as a correction.

Materials

Aided AAC systems used by students.

Deedee and Sophie were both allocated individual and customised versions of the same type of low-tech core communication boards and high-tech speech generating devices.

The low-tech AAC systems were communication boards with a set of core words (Tobii Dynavox Picture Communication Symbols®) issued by TalkLink (n.d.-b) (see Figure 1.), with a customised set of 'fringe' words next the core words and straps to enable them to be worn.



The Picture Communication Symbols ©1981-2018 by Tobii Dynavox. All Rights Reserved Worldwide. Used with permission. Boardmaker® is a trademark of Tobii Dynavox.

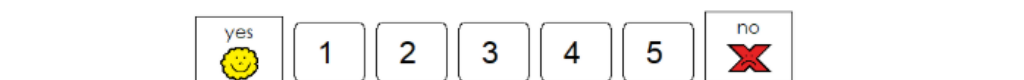


Figure 1. Photo of Tobii Dynavox Picture Communication Symbols® pictures displayed on communication boards used by Deedee and Sophie (TalkLink, n.d.-b).

The high tech aided AAC systems were an iPad® with the communication application LAMP Words for Life® (Language Acquisition through Motor Planning, n.d.) installed to facilitate the picture display and to generate speech. A photo of the LAMP Words for Life® application interface used by Deedee and Sophie is provided in Figure 2.

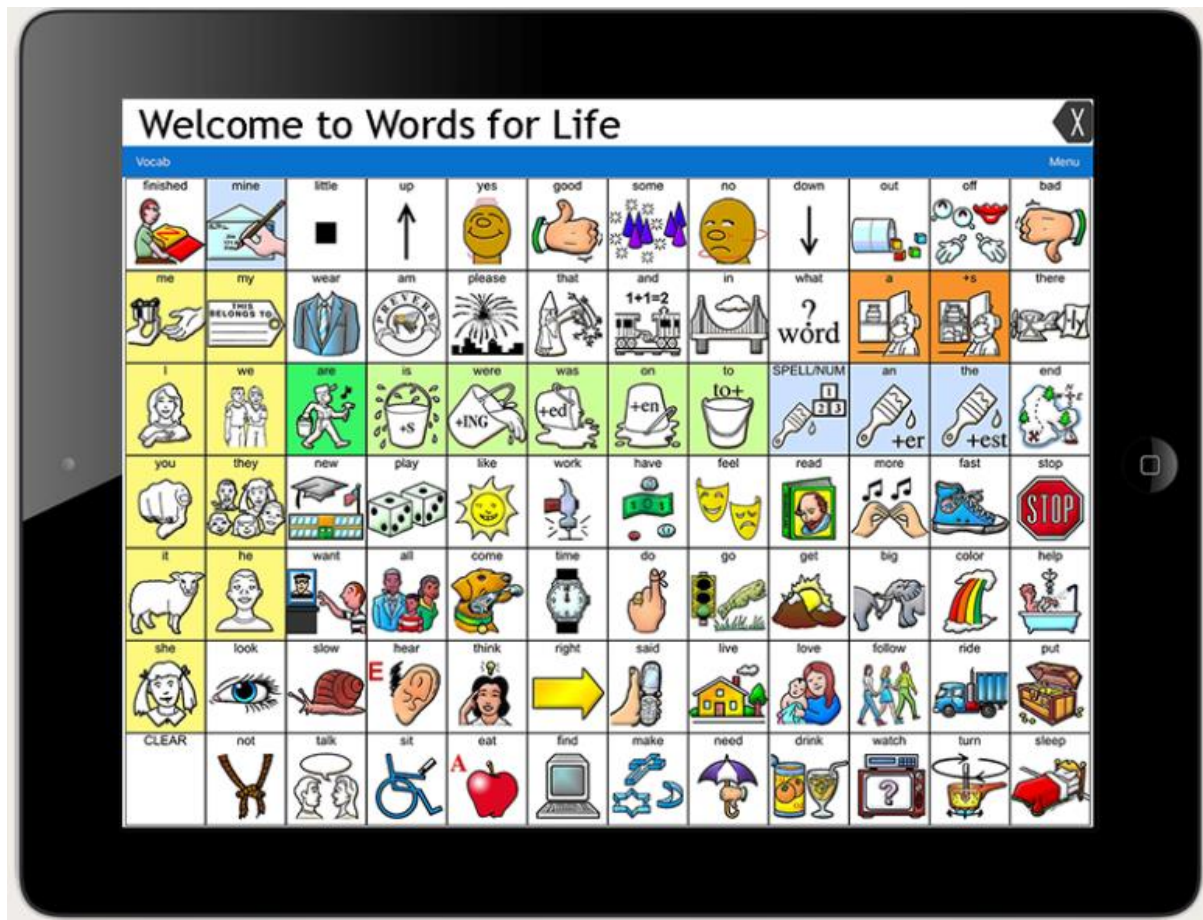


Figure 2. Photo of the LAMP Words for Life® communication application interface used by Deedee and Sophie (Language Acquisition through Motor Planning, n.d.).

Data collection sheet.

Pre-printed data collection sheets (see Appendix H) were used to record the type of communicative episode, and the associated environmental variables, as they occurred. Observation sheets included space for observers to record: name of focus student participant, date and time, setting (including a brief description), observer name, IOA session, and space to include additional field notes relevant to each communicative episode that occurred. The data sheet was formatted into three main sections, antecedent conditions, students' communicative behaviours, and behaviours of staff participants. Each dependent variable option was pre-printed on the data collection sheet to allow observers to circle the appropriate variable code as each communicative episode occurred.

Procedure

Ethical approval.

Ethical approval to conduct this research was granted by the University of Waikato Human Research Ethics Committee (Health) (approval number 19:53). The school principal and special education head teacher were emailed, with study advertisement (Appendix A) and organisation information sheet (Appendix B) attached, and invited to provide permission to recruit students and staff from within their school for participation in this study.

Participant recruitment and selection.

After obtaining written permission from the school principal and Special Education Unit (SEU) head teacher, potential participants were recruited. The SEU head teacher nominated potential participants and provided them (or students' caregivers) with a study advertisement and relevant participant information sheet (see staff and student information sheets: Appendices C and E). Potential participants (or students' caregivers) were invited to contact the researcher directly if they were interested in participating and/or to ask any questions about the research. After obtaining informed consent in writing (see Appendix F) from students' caregivers, the researcher provided student participants with a simplified explanation of the study purpose, and asked students to indicate their assent to participate. Staff participants were recruited after they expressed their interest in participating, and staff participants provided their informed consent in writing (see Appendix D).

Naturalistic event-recording observations.

Naturalistic observation sessions were conducted using event-recording procedures (Cooper et al., 2014) and pencil and paper (see data collection sheet, Appendix H) to record all communicative episodes with students as they happened. Student and staff participants were instructed to continue with their usual routines while being observed. All communicative episodes that occurred with focus students were captured. If no

communicative episodes occurred during an entire observation session, these sessions were still included in the results. The lead researcher (and inter-observer) conducted all observations in person and in the most unobtrusive manner possible. All observations were conducted in separate 20-minute sessions over a total observation time of 18 hours (1080 minutes). Each student was observed for at least five hours (300 minutes) in total ($M = 360$, range = 300 - 420) during October and November 2019.

Observational sessions were balanced across settings (special education classroom (360 minutes, 33.33%), non-academic setting (420 minutes, 38.89%), and community setting (300 minutes, 27.78%). All participants were observed during their typical school routines only, and no students were observed during specialised therapy or treatment (for example, during speech and language sessions). Observation timing was paused if a student went to complete a personal or private task (such as using the bathroom), and timing of the observation was resumed once they returned. Variations in length of observation time and settings resulted from students' varied schedules.

Inter-observer agreement.

Inter-observer agreement (IOA) observation sessions were completed for 33.33% of the total number of observation sessions. An applied behaviour analysis post-graduate student, familiar with Skinner's analysis of verbal behaviour, acted as an additional data collector. Both observers trained using YouTube™ videos to practice coding until the primary and secondary observer reached 100% agreement. To calculate an IOA percentage, the number of agreements were divided by the number of disagreements plus the number of agreements, the sum was then converted to a percentage. Overall reliability was calculated and produced a mean inter-observer agreement of 98.34% ($SD = 2.64$, range = 91.67-100%) across all dependent variables. The average inter-observer agreement reached for each dependent variable were: communicative episode :100%; communication partner: 100%;

communication mode: 95.77% (range = 66.67-100%); communicative function: 95.85% (range = 66.67-100%); Student access to AAC: 100%; number of additional prompts: 99.07% (range = 83.33-100%); prompt type: 98.61% (range = 75.00-100%); and consequence: 96.64% (range = 71.43-100%). Results of 80.00% or more agreement are required to meet evidence standards (Cooper et al., 2014; Kratochwill et al., 2010), so the level of agreement found in this study indicated adequate consistency and accuracy of data collection.

Data analysis.

Observation data were summarised for each student participant individually, and in aggregate, across total observations in each setting, type of communicative episode, and student. No instances of use of the large communication board were observed with students or staff so this mode was removed. The individual and combined results were reported using descriptive statistics. Descriptive statistics (percentage of totals, means, and standard deviations) and communicative episode frequencies and rates per hour were presented in graphs and tables. Total observation duration and the total number of communicative episodes observed were tallied. The rate of communicative episodes were calculated by dividing the number of communicative episodes by the observation time and converting this to a rate per hour. Percentage of the total, means, and standard deviations for each communicative episode type across settings, communication partner, mode, function, access to AAC systems, prompts, and consequences were calculated and presented in tables and graphs.

A verbal behaviour approach was used to determine if staff provided consequences (responses) that were functionally appropriate matches to student initiations. The code(s) applied to the consequences provided by staff were compared to the function code(s) of each student initiation, then the staff response(s) were assessed as constituting a functionally appropriate *match*, *may match*, or *no match*. Based on the verbal operants outlined by

Skinner (1957), functionally appropriate responses to communicative episodes with mand functions included direct reinforcement such as *tangible access* or *help, information, or assistance provided, compliance, and escape task or activity*. Whereas functionally appropriate responses to communicative acts with tact, echoic, or intraverbal functions included generalised social and educational reinforcement such as *attention or praise, correction, or reprimand*. For example, a communicative episode where a student initiated towards a staff participant to request a pen was coded with a mand function (student wanted or needed a pen and asked for a pen) and/or a tact function (if pen is present). If a staff response was to provide the student with a pen (tangible access) or to help the student gain access to a pen (help, information, or assistance provided), then the staff response was assessed as a functionally appropriate match. Whereas, if the staff response was instead to provide *attention or praise alone* (staff said, *good job using your words*, alongside a thumbs-up gesture) but did not provide *tangible access* or *help, information, or assistance* to the student to obtain a pen, then this consequence was assessed as *no match* to the communicative function. Consequences were coded as *may match* the function if the staff response included both *attention or praise* and *tangible access*. Instances of staff providing no response were coded as *no match* for all communicative episodes irrespective of the function.

Results

Student participants were observed over 18 hours (1080 minutes) of total observation time across 432 total communicative episodes, as summarised in Table 1, communicative episodes occurred at an overall mean rate of 24.71 per hour ($SD = 11.49$, range = 13.67-36.60).

Table 1

Summary of Total Communicative Episodes, Types, and Rates for Bella, Deedee, and Sophie

	Observation time	Number of communicative episodes				Rate of communicative episodes (per hour)			
	Minutes	Opportunities to respond	Student initiations	Opportunities to initiate	Total	Opportunities to respond	Student initiations	Opportunities to initiate	Total
Bella	300	54	129	0	183	10.80	25.80	0.00	36.60
Deedee	420	146	21	0	167	20.86	3.00	0.00	23.86
Sophie	360	77	4	1	82	12.83	0.67	0.17	13.67
Total	1080	277	154	1	432				
Mean	360	92.33	51.33	0.33	144	14.83	9.82	0.06	24.71
SD	60	47.88	67.80	0.58	54.29	5.32	13.89	0.10	11.49

Rate and Type of Communicative Episodes

The majority ($n = 277$, 64.12%) of communicative episodes observed were student participants encountering opportunities to respond, at a mean rate of 14.83 episodes per hour ($SD = 5.32$, range = 10.80-20.86). Student initiations ($n = 154$) accounted for 35.65% of all communicative episodes and were emitted by student participants at an average rate of 9.82 per hour ($SD = 13.89$, range = 0.67-25.80). During the entire study, one student participant (Sophie) experienced a single (0.23%) opportunity to initiate which equated to an overall rate of 0.06 per hour.

Deedee experienced the most opportunities to respond, ($n = 146$, 52.71%) at the highest average rate of 20.86 episodes per hour, followed by Sophie at 12.83 episodes per hour ($n = 77$, 27.80%), while Bella encountered opportunities to respond ($n = 54$) at the lowest overall mean rate of 10.80 episodes per hour. The majority of all student initiations were emitted by Bella ($n = 129$, 83.77%) and occurred at the highest average rate of 25.80 per

hour, followed by Deedee and Sophie who emitted student initiations at lower rates of 3.00 ($n = 21$, 13.64%) and 0.67 ($n = 4$, 2.60%) per hour, respectively.

A summary of types of communicative episodes and rates per hour for Bella, Deedee, and Sophie across settings are presented in Figure 3.

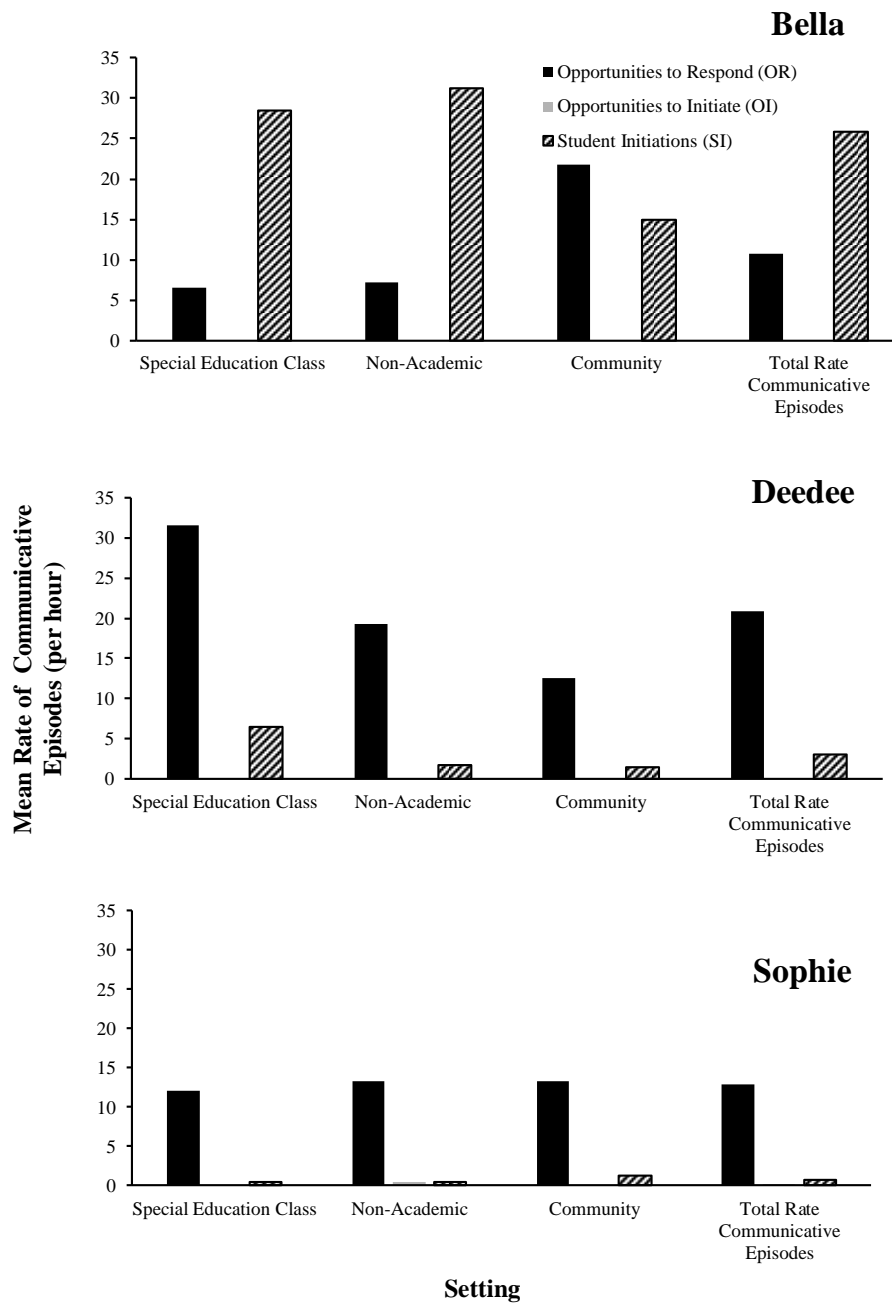


Figure 3. Rate and type of communicative episodes for Bella, Deedee, and Sophie as a function of setting.

Combined results show evidence of varied frequencies of communicative episodes across settings but similar rates, and opportunities to respond were the most common episode type overall. Episodes observed within the special education classroom ($n = 171$, 39.58%) occurred at an overall mean rate of 28.50, and were most often opportunities to respond ($n = 100$, 58.48%) and 71 student initiations. Within non-academic settings ($n = 160$, 37.04%), a mean rate of 24.51 communicative episodes per hour occurred, and opportunities to respond ($n = 101$, 63.13%) were again the most common type of communicative episodes observed, followed by student initiations ($n = 58$, 36.25%) and the single opportunity to initiate (0.63%). In community-based settings, 101 (23.38%) communicative episodes were observed at a mean rate of 21.72 per hour and were predominantly opportunities to respond ($n = 76$, 75.25%) and student participants emitted 25 (24.75%) initiations while participating in activities within their community.

Bella was involved in the greatest number of communicative episodes observed ($n = 183$), at a mean rate of 36.60 episodes per hour over 300 total minutes of observation time (see Table 1). As shown in Figure 1., Bella was the only student who was observed overall more frequently emitted initiations ($n = 129$, 70.49%) compared to encountering opportunities to respond ($n = 54$). Bella most frequently initiated within special education ($n = 57$) and non-academic settings ($n = 52$) at mean rates of 28.50 and 31.20, respectively. A unique pattern of communicative episodes occurred for Bella in community settings where she initiated less frequently ($n = 20$) than she was observed during opportunities to respond ($n = 29$) and opportunities to respond were observed occurring at a higher rate ($M = 21.75$ per hour) in comparison to initiations that Bella emitted within community settings ($M = 15$ per hour). Within the special education classroom, opportunities for Bella to respond ($n = 13$, 18.57%) occurred at an average rate of 6.50 per hour, similar to non-academic settings 12 (18.75%) where the average rate was 7.20 opportunities per hour. Research notes highlighted

that during community-based observation sessions, staff were observed asking Bella a large number of safety oriented questions (opportunities to respond). For example, staff were observed asking Bella if it was safe to talk to strangers and whether it was safe to cross the road.

Deedee was the focus of 167 total communicative episodes that occurred on average 23.86 times per hour over 420 total observation minutes (as shown in Table 1.). Within all three settings, Deedee predominantly encountered opportunities to respond ($n = 146$, 87.43%) that were observed at the highest rate of opportunities to respond for any student. Deedee most often experienced opportunities to respond within special education ($n = 63$, 82.89%) at an average rate of 31.50 episodes per hour, which was the highest rate of opportunities to respond that were observed in any setting with any student. Likewise, within non-academic settings, Deedee mostly encountered opportunities to respond ($n = 58$, 92.06%) at a mean rate of 19.33 per hour, but frequency ($n = 25$) and rate (12.50 per hour) were lowest within community settings. Initiations by Deedee primarily occurred within the special education class ($n = 13$, 61.90%) at the highest mean rate of 6.50 episodes per hour. The average rates and frequencies of initiations were similar, but lower, within non-academic ($n = 5$, rate = 1.67 per hour) and community ($n = 3$, rate = 1.50 per hour) settings for Deedee. During one non-academic observation session, Deedee initiated towards the observer while at morning tea, which was a rare example of Deedee initiating a communicative episode.

Sophie was the focus of 82 total communicative episodes that, over 360 minutes of total observation time, occurred at an average rate of 13.67 episodes per hour (refer to Table 1). Sophie predominantly encountered opportunities to respond ($n = 77$, 93.90%) within all three settings at similar frequencies and rates. Sophie encountered response opportunities most often within non-academic settings ($n = 31$, 40.26%) at the highest mean rate of 13.29 episodes per hour, followed by a rate of 13.20 per hour within community ($n = 22$, 28.57%)

and 12 per hour within special education ($n = 24$, 31.17%). During the entire study, very few student initiations by Sophie ($n = 4$, 4.88%) were observed. Sophie was observed initiating twice (50.00%) during a single community-based observation, equating to a mean of 1.20 per hour, and one initiation was observed within each of the special education (rate = 0.43 per hour) and non-academic (rate = 0.43 per hour) settings. The initiations by Sophie within community settings were observed during a session where students went out for lunch and other diners were served their meal before Sophie had received her food. Sophie experienced the one opportunity to initiate (1.22%) episode that was observed within a non-academic setting, equating to an overall average rate of 0.17 opportunities to initiate per hour. Sophie was observed receiving a food item that required assistance to open and anecdotal research notes indicated that this was a deliberate sabotage attempt because the observer heard the communication partner indicate that they were purposefully passing Sophie the item she required help with in order to see how Sophie would respond.

Communication Mode

Communication mode was not a mutually exclusive category; student participants used single and combinations of modes during communicative episodes. Overall, as shown in Figure 4., student participants utilised intelligible vocalisations during the majority ($n = 337$, 78.01%) of communicative episodes, followed by gestures ($n = 74$, 17.13%), but were less frequently observed using aided (high and low-tech) AAC devices, unaided (sign language) AAC systems, or unwanted communicative behaviours.

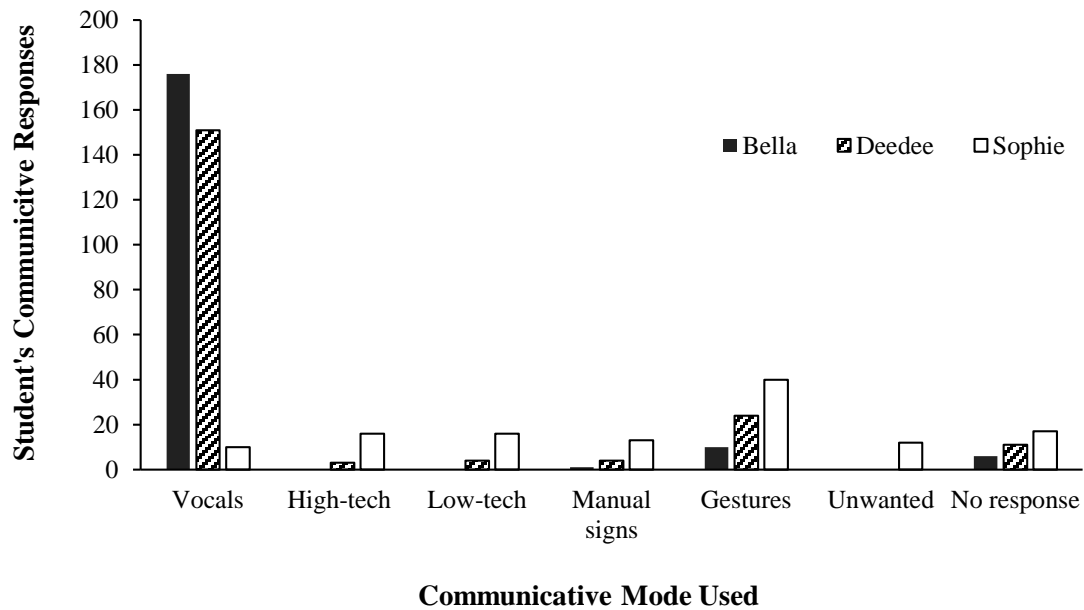


Figure 4. Number of times communication mode used by Bella, Deedee, and Sophie during all communicative episodes.

Vocalisations.

Of the total communicative episodes using vocalisations, the bulk were by Bella ($n = 176$, 52.23%) and Deedee ($n = 151$, 44.80%), whereas Sophie used vocalisations infrequently ($n = 10$, 2.97%). For Bella, during the majority ($n = 166$, 90.71%) of communicative episodes she used vocalisations alone. Deedee also used vocalisations alone during most of her total communicative episodes ($n = 123$, 73.65%), and used vocalisation in combination with other modes during the remaining 28 episodes. This pattern was not the same for Sophie who only used vocalisations in combination with other modes. Mostly ($n = 8$, 80.00%) combinations of vocalisations, gesture, and sign language.

Gestures.

Gestures were the second most frequently used communication mode overall, and were used by student participants during 17.13% ($n = 74$) of the total communicative episodes observed. Sophie used gestures more often ($n = 40$, 54.05%) than Deedee ($n = 24$, 32.43%) and Bella ($n = 10$), and Sophie used gestures more frequently than any other

communication mode whereas gestures were the second most utilised mode for Deedee and Bella. During almost a third ($n = 12$, 30.00%) of episodes, Sophie used gestures alone, while Deedee and Bella used gestures alone during four and one episodes, respectively. Pointing with no aided AAC system present (as was observed with Sophie) was coded as gestural, however when an aided AAC systems was present the same behaviour (pointing) was coded as use of high or low-tech AAC systems.

Aided AAC devices.

Generally, student participants used AAC systems less frequently than other communication modes. Aided communication systems were used during 9.03% ($n = 39$) of the total communicative episodes observed, which included use of a low-tech communication board ($n = 20$, 51.28%) and high-tech AAC device ($n = 19$, 48.72%) a similar number of times during the entire study. Sophie's use of aided AAC systems ($n = 32$, 82.05%) accounted for the majority of instances. Following use of gestures, aided AAC systems were the next most frequently used communication modes by Sophie, and included equal frequency of use of high-tech ($n = 16$) and low-tech ($n = 16$) systems. Deedee used high-tech ($n = 3$, 7.69%) and low-tech ($n = 4$, 10.26%) AAC systems during approximately one fifth of the total number of episodes that included aided AAC systems. Bella was not observed using an aided AAC system during the entire study. An aided AAC device alone was coded as the communication mode during 51.28% ($n = 20$) of the episodes with aided systems, these were with Sophie ($n = 19$) and Deedee ($n = 1$). These episodes with Sophie were all coded as echoic responses and were all prompted by staff participants using the same AAC device.

Unaided AAC system.

Sign language was used as a communication mode during 4.17% ($n = 18$) of the total episodes, and all but one episode (by Sophie) occurred in combination with other modes. Sophie ($n = 13$, 72.22%) and Deedee ($n = 4$, 22.22%) used manual signs more frequently than

Bella who signed once during the entire study. The combined total of students' use of gesture and manual signs observed in this study was 20.30% of the total communicative episodes.

Unwanted behaviours.

Of the total communicative episodes observed, unwanted behaviours were coded during 2.78% ($n=12$) episodes with Sophie only, and were the least frequently observed mode. During two of these episodes unwanted behaviours alone were coded, eight instances of unwanted behaviour occurred alongside gestures, while the remaining two occurred together with either sign language or a low-tech AAC system.

Overall, there were no responses made by student participants following 34 (12.27%) of the 277 total opportunities to respond they encountered. Sophie did not reply to 17 (22.08%) of the 77 opportunities to respond she experienced, and during two of these episodes no AAC system was available to Sophie. Deedee did not respond to 11 (7.53%) of the 146 total opportunities to respond she experienced and during most ($n = 7$, 63.64%) of these episodes there was an AAC system available. Bella did not respond to six (11.11%) of the 54 total opportunities to respond she experienced, and during three of these episodes there was no AAC system available.

Access to aided systems and frequency of communication when available.

In total, student participants had access to an aided AAC system (high or low-tech) during most ($n = 263$, 60.88%) of the total communicative episodes observed and these were most often within the student's reach ($n = 240$, 91.25%) or within their location ($n = 23$). Because Deedee and Sophie (but not Bella) had communication goals that focussed on the use of aided AAC systems and were the only students allocated with individual aided AAC devices (both high and low-tech), only the communicative episodes with Deedee and Sophie ($n=249$) were further examined and are summarised in Figure 5.

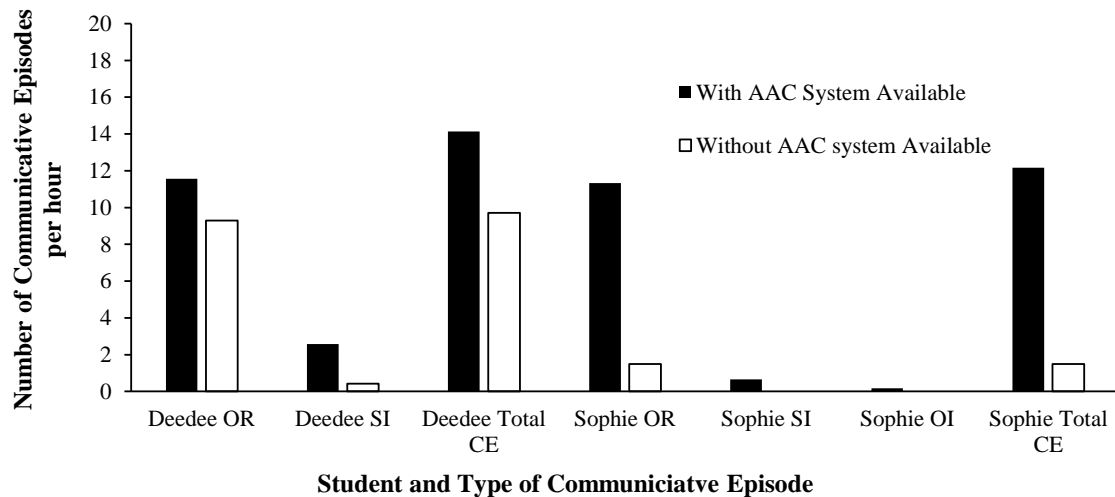


Figure 5. Rates of communicative episodes with Deedee and Sophie as a function of communicative episode types (opportunities to respond (OR), student initiations (SI), and opportunities to initiate (OI)) with and without an AAC system available.

Deedee and Sophie had access to an aided AAC system during 69.08% ($n = 172$) of their total communicative episodes, and no aided AAC system was available during the remaining episodes ($n = 77$). Of the total communicative episodes with Deedee ($n = 167$), she had access to an aided AAC system during more than half of these episodes, ($n = 99$, 59.28%) and used an aided AAC system as a communication mode during 7.07% ($n = 7$) of these instances. Similarly, Sophie had an aided AAC system available during the majority ($n = 73$, 89.02%) of her total communicative episodes ($n = 82$), and used an aided AAC system as her communication mode during less than half ($n = 32$, 43.83%) of these episodes.

In general, rates of communicative episodes were higher on average for both Deedee (14.14 per hour) and Sophie (12.17 per hour) when an aided AAC system was available, compared to when no system was available for Deedee (9.71 per hour) or Sophie (1.50 per hour) to use. When an aided AAC system was available, rates of opportunities for Deedee to respond (11.57 per hour) and initiations (2.57 per hour) were both higher, in comparison to rates observed when no AAC system was available of 9.29 and 0.43, respectively. Similarly, when an aided AAC system was available the rates of opportunities for Sophie to respond

(11.33 per hour), or to initiate (0.17 per hour), and student initiations (1.50 per hour) all occurred at higher rates than when there was no aided AAC system available. When no aided AAC system was available, rates of opportunities for Sophie to respond, to initiate, and student initiations all occurred at lower rates of 11.33, 0.00, 0.67 episodes per hour, respectively.

Communicative Function

Communicative function was not a mutually exclusive category, and verbal behaviours are frequently multiply controlled, consequently both single and multiple functional codes were assigned to communicative episodes. The functions assigned to all communicative episodes are displayed in Table 2.

Table 2

Summary of Communicative Episode Function for Bella, Deedee, and Sophie

Communicative Function	Bella	Deedee	Sophie	Total	% of total episodes	<i>M</i>	<i>SD</i>
Mand functions							
Pure mand	6	0	0	6	1.39	2.00	3.46
Mand and intraverbal	1	15	16	32	7.41	10.67	8.39
Mand, intraverbal, and echoic	0	5	14	19	4.40	6.33	7.09
Mand and tact	81	8	5	94	21.76	31.33	43.04
Mand, tact, and echoic	0	1	0	1	0.23	0.33	0.58
Mand, tact, and intraverbal	1	3	0	4	0.93	1.33	1.53
Mand, tact, intraverbal, and echoic	0	4	0	4	0.93	1.33	2.31
Total mand	89	36	35	160	37.04	53.33	30.89
Tact functions							
Pure tact	42	13	0	55	12.73	18.33	21.50
Tact and intraverbal	30	49	9	88	20.37	29.33	20.01
Tact, intraverbal, and echoic	2	13	17	32	7.41	10.67	7.77
Total	74	75	26	175	40.51	58.33	28.01
Total tact (including from section above)	156	91	31	278	64.35	92.67	62.52
Intraverbal functions							
Pure intraverbal	14	19	4	37	8.56	12.33	7.64
Intraverbal and echoic	0	23	0	23	5.32	7.67	13.28
Total	14	42	4	60	13.89	20.00	19.70
Total intraverbal (including from sections above)	48	131	60	239	55.32	79.67	44.86
Echoic functions							
Pure echoic	0	3	0	3	0.69	1.00	1.73
Total echoic (including from sections above)	2	49	31	82	18.98	27.33	23.71

Note. Communicative function was not a mutually exclusive category, some episodes were assigned multiple functions in various combinations, totals may exceed 432 total communicative episodes and 100%.

Tact.

A tact function was applied to 64.35% ($n = 278$, $M = 92.67$, $SD = 62.52$) of the total communicative episodes, and was the most frequently observed verbal operant. In total, the majority of episodes involving tacts ($n = 156$, 56.12%) were observed with Bella who also emitted the majority of pure tacts ($n = 42$, 76.36%), followed by Deedee ($n = 91$, 32.73%) who was primarily observed during tact and intraverbal combinations ($n = 49$, 53.85%), and emitted 13 (23.64%) pure tacts. No pure tact function was coded to communicative episodes with Sophie, and Sophie was observed during the fewest ($n = 26$, 9.35%) episodes coded as tacts.

Intraverbal.

The second most frequently coded verbal operant was intraverbal, which accounted for 55.32% ($n = 239$, $M = 79.67$, $SD = 44.86$) of the total communicative episodes observed. Intraverbal functions (including episodes coded in combinations) were primarily coded to episodes that occurred with Deedee ($n = 131$, 54.81%), followed by Sophie ($n = 60$, 25.10%), and the remaining 20.08% ($n = 48$) were applied to episodes with Bella. An example of a pure intraverbal observed with Deedee was an episode where a staff participant asked about a prior event by saying, *how was swimming?* to which Deedee responded vocally by saying *good, good*.

Mand.

The function of mand was assigned to 37.04% ($n = 160$, $M = 53.33$, $SD = 30.89$) of the total communicative episodes, and was the third most frequently assigned verbal operant. Mand episodes were most often coded for Bella ($n = 89$, 55.63%), followed by Deedee ($n = 36$, 22.50%) and Sophie ($n = 35$) who had similar numbers of episodes coded as mands. In total, six pure mands (all with Bella) were observed during the entire study. An example of a pure mand emitted by Bella was her independently requesting that the communication partner

provide a specific food item she wanted for a future lunch. Mand-based episodes were most frequently coded as combinations of mand and tact ($n = 94$, 58.75%), followed by mand and intraverbal ($n = 32$, 20.00%), then mand, intraverbal, and echoic ($n = 19$, 11.88%).

Echoic.

Echoic function was applied to 18.98% ($n = 82$, $M = 27.33$, $SD = 23.71$) of the total communicative episodes observed. The majority of echoic verbal operants ($n = 49$, 59.76%) were observed with Deedee, three of which were coded as pure echoic, and Deedee used vocalisations during all echoic-based episodes. Episodes with Sophie accounted for 37.80% ($n = 31$) of all echoic verbal operants witnessed, and in all but three ($n = 28$, 90.32%) instances an aided AAC system was used to imitate the response. The remaining two echoic-based episodes were with Bella who used vocalisations in all instances.

Student initiations.

By definition initiations are unprompted and as a result, when students initiated ($n = 154$) communicative episodes, these were coded as mand, mand and tact, or tact based verbal operants only. The function codes most frequently assigned to student initiations were tacts ($n = 148$, 96.10%) and 58 of these were assigned a pure tact function, followed by mands ($n = 99$, 64.29%) of which six were coded as pure mands. A communicative episode coded as a mand and tact initiation occurred with Deedee when she was observed initiating towards a staff participant by saying *hungry* when the school bell rang.

Opportunities to initiate.

Sophie's response to the opportunity to initiate she experienced was coded as a mand episode. Specifically, Sophie was provided with an item of food that she required assistance to open and Sophie was observed initiating an attempt to request that the communication partner provide the help required.

Opportunities to respond.

By definition opportunities to respond are prompted by verbal stimuli, as a result the majority were coded as intraverbal ($n = 239$, 86.28%), and 37 were recorded as being intraverbal function only. A tact code was applied to 129 (46.57%) opportunities to respond. An echoic function was applied to 82 (29.60%) response opportunities in total. The function of mand was assigned to 60 (21.66%) of the 277 total opportunities to respond that students experienced. Some episodes observed with Deedee showed evidence of limitations to the intraverbal responses observed. One example where Deedee's response was part echoic was an episode when a staff participant asked, *what did we go and see in [name of town] yesterday?* to which Deedee replied by repeating the name of the town. The second example of Deedee during intraverbal responding but one that represented another incorrect response, occurred when Deedee had removed all of the fish from the sushi she had chosen and a staff participant asked about this by saying, *don't you like fish?* Deedee responded by saying fish. An example of intraverbal responding observed with Sophie occurred when Sophie nodded in response to a staff participant asking her the question, *what are you staring at, are you watching [name of peer's] food?*

Communication Partners

During the total communicative episodes observed (displayed in Table 3), students predominantly encountered adults ($n = 392$, 90.74%) and less frequently peers ($n = 50$, 11.57%).

Table 3

Summary of Communication Partners and Additional Prompts Delivered by Staff with Bella, Deedee, and Sophie

	Bella	Deedee	Sophie	Total	Total % Episodes
Communicative Episode Partner					
Staff participants	128	140	59	327	75.69
Opportunities to respond	50	127	56	233	53.94
Student initiations	78	13	3	94	21.76
Other adults	18	27	20	65	15.05
Opportunities to respond	4	19	18	41	9.49
Student initiations	14	8	1	23	5.32
Opportunities to initiate	0	0	1	1	0.23
Peers	37	10	3	50	11.57
Opportunities to respond	0	10	3	13	3.01
Student initiations	37	0	0	37	8.56
Total with adults (staff and other combined)	146	167	79	392	90.74
Total with peers	37	10	3	50	11.57
Total communicative episodes	183	177	82	442	
Opportunities to Respond with Staff Participants					
Number of prompts delivered by staff					
No additional prompt total	32	59	8	99	42.49
One additional prompt	11	43	30	84	36.05
Two additional prompts	4	10	13	27	11.59
Three additional prompts	1	5	3	9	3.86
Four additional prompts	4	0	1	5	2.15
Five additional prompts	0	7	1	8	3.43
Eight additional prompts	0	1	0	1	0.43
Total additional prompts delivered	18	68	48	134	57.51
Total opportunities to respond with staff participants	50	127	56	233	

Note. Communication partner was not a mutually exclusive category, 10 episodes with Deedee were assigned multiple partners, total communicative episodes exceeded 432 and 100%.

Bella (9.76%), Deedee (46.34%), and Sophie (43.90%) all experienced opportunities to respond to adults other than the staff participants ($n = 41$), and Sophie encountered one opportunity to initiate. Deedee ($n = 10$) and Sophie ($n = 13$), but not Bella, encountered opportunities to respond to peers. Students were observed initiating towards adults other than staff participants ($n = 23$), of which 60.87% ($n = 14$) were by Bella, by Deedee ($n = 8$, 34.78%), and once by Sophie. Bella was the only student who initiated towards peers ($n = 37$) which equated to 8.56% of the total communicative episodes. Ten episodes were observed with multiple partners during the same communicative episode, all of which were with Deedee when a staff participant directed her to communicate with another person.

Data related to the behaviours of communication partners (prompts delivered and responses produced) were only recorded during episodes when the student's communication partner was a staff participant ($n = 327$, 75.69%). Opportunities to respond accounted for 71.25% ($n = 233$) of the total episodes that occurred with staff, and the remaining 94 episodes were all student initiations (28.25%). Deedee's communication partners were staff participants during 83.83% ($n = 140$) of her total communicative episodes, 127 (90.71%) of these were opportunities to respond, and the remaining 13 episodes were initiations by Deedee. Staff were Bella's communication partners during 69.95% ($n = 128$) of her total communicative episodes, of these 78 (60.94%) were initiations emitted by Bella, and the remaining 50 episodes were opportunities for Bella to respond. Sophie's communication partners were staff for the majority ($n = 59$, 71.95%) of total episodes observed with Sophie. Episodes between Sophie and staff were predominantly opportunities for Sophie to respond ($n = 56$, 94.92%) and Sophie initiated towards staff three times.

Prompts delivered by staff participants.

By definition, opportunities to respond were prompted whereas student initiations and opportunities to initiate were unprompted; consequently only additional prompting (frequency and type) provided by staff that occurred after initial opportunities to respond were documented. Of the total 233 opportunities for students to respond that occurred with staff participants, 42.49% ($n = 99$) of these episodes did not include additional prompts (as per Table 3). Staff were not observed delivering additional prompts during episodes primarily with Deedee (59.60%) and Bella (32.32%), and during eight (8.08%) opportunities to respond with Sophie.

Number of prompts.

Staff did deliver additional prompts during the remaining 57.51% ($n = 134$) of the total opportunities to respond with students, these were primarily provided to Deedee

(50.75%) and Sophie (35.82%), and during 13.43% Bella received additional prompts to communicate. Staff were observed delivering one additional prompt during ($n = 84$, 62.69%) of episodes where additional prompts were used, most often towards Deedee ($n = 43$, 51.19%), then Sophie ($n = 30$, 35.71%), and Bella ($n = 11$, 13.10%). Staff delivered two additional prompts during 20.15% ($n = 27$) of episodes where additional prompts were provided, and these were mostly directed towards Sophie ($n = 13$) and Deedee ($n = 10$) but less often with Bella ($n = 4$). For the remaining opportunities to respond where additional prompts were delivered ($n = 22$), staff provided three ($n = 9$), four ($n = 5$), or five ($n = 8$) additional prompts during a single communicative episode. Instances where staff provided five additional prompts ($n = 8$) to elicit a student response occurred during one episode with Sophie and most often during episodes with Deedee ($n = 7$), and one instance of eight additional prompts were observed being delivered to Deedee. Staff were observed providing an average of 1.75 ($SD = 1.27$, range = 1-8) additional prompts per communicative episode.

Of the 233 total instances of opportunities to respond where no response from the student was observed ($n = 34$), the communication partners were staff during 70.59% ($n = 24$) of these episodes. No additional prompts to elicit a response from the student were delivered by staff during 45.83% ($n = 11$) of these episodes. During the remaining 54.17% of episodes where no responses from Bella ($n = 2$), Deedee ($n = 3$), nor Sophie ($n = 8$) were observed, staff had provided one ($n = 6$), two ($n = 4$), three ($n = 2$), or four ($n = 1$) additional prompts to elicit a response from students.

Prompt types.

During the 134 total opportunities to respond, where staff provided additional prompts, staff pointed to pictures on aided AAC systems (high and low-tech AAC model or non-model) to prompt Deedee or Sophie to communicate, and were the prompt type most often used by staff ($n = 66$, 49.25%). Vocal prompts ($n = 61$, 45.52%) included

vocalisations alone ($n = 32$, 55.17%) or vocal prompts in combination with other prompt types ($n = 32$), and vocalised prompts were the second most frequently used prompt type. Staff used gestural prompts (for example, staff pointed to a written letter of the alphabet in an attempt to elicit a communicative response from the student such as vocalising the name or sound of the letter) during 27.61% ($n = 41$) of the episodes where additional prompting was provided. Of these, gestural prompts alone ($n = 23$, 56.10%) were most commonly delivered, followed by gestures in combination with vocal prompts ($n = 13$, 31.71%).

A total of 30 communicative episodes with Sophie were prompted by staff at least one additional time and were coded with an echoic function. During almost all ($n = 29$, 96.67%) of these episodes AAC system model or non-model type prompts were observed equally often, and the communication mode used by Sophie to emit the echoic response was the same aided system that was used by staff to prompt the response. An example of a non-model type prompt observed during this research was when staff pointed to a picture that represented the ‘word’ *wait* on a communication board and vocally stated to the student (Sophie) that she needed to wait.

Consequences Following Communicative Episodes

Of the total communicative episodes with staff ($n = 327$), almost a third ($n = 94$, 29.65%) were student initiations. As summarised in Table 4, most of the communicative episodes that were initiations towards staff were emitted by Bella ($n = 78$, 82.98%), whereas fewer initiations were observed with Deedee ($n = 13$, 13.83%) and Sophie ($n = 3$, 3.19%).

Table 4

Summary of Consequences as Matches to Student Initiation Function for Bella, Deedee, and Sophie

Student Initiations Towards Staff	Bella	Deedee	Sophie	Total	Match Yes/May/No
Communicative function					
Pure mands	6	0	0	6	
Mand and tact	44	4	3	51	
Pure tacts	28	9	0	37	
Total student initiations	78	13	3	94	
Consequences following pure mand episodes					
Attention or praise & Tangible access	1	0	0	1	Yes
Help or assistance only	1	0	0	1	Yes
Correction & Help or assistance	1	0	0	1	May
Attention or praise only	1	0	0	1	No
No response	2	0	0	2	No
Consequences following mand and tact episodes					
Tangible access only	1	0	0	1	Yes
Help or assistance only	4	0	0	4	Yes
Attention or praise & Escape from activity	0	1	0	1	Yes
Attention or praise & Help or assistance	3	1	1	5	Yes
Attention or praise & Correction	3	0	2	5	May
Correction & Help or assistance	1	0	0	1	May
Attention or praise only	8	0	0	8	No
Correction only	7	2	0	9	No
Reprimand only	5	0	0	5	No
No response	12	0	0	12	No
Consequences following pure tact episodes					
Attention or praise only	15	6	0	21	Yes
Attention or praise & Correction	3	1	0	4	May
Correction only	3	0	0	3	May
No response	7	2	0	9	No
Total functionally appropriate matches or may match	36	9	3	48	
Total functionally inappropriate no match	42	4	0	46	
Total staff no response to student initiations	21	2	0	23	
Total consequences following student initiations	78	13	3	94	

The codes applied to the consequences provided by the staff were compared to the function code(s) of each student initiation and assessed as to whether the consequence constituted a functionally appropriate *match* (yes), *may match* (may), or *no match* (no). Overall, the consequences delivered by staff following student initiations ($n = 94$) were assessed as functionally appropriate *matches* ($n = 34$, 36.17%) or *may match* ($n = 14$, 14.89%) for just over half of the total student initiations ($n = 48$, 51.06%). The remaining 48.94% ($n = 46$) were instead assessed as functionally inappropriate *no match*, and half of these ($n = 23$) were coded as *no response* from staff.

Consequences following pure mand communicative episodes.

Bella was the only student who initiated episodes that were coded as a pure mand ($n = 6$), and five categories of consequences were delivered by staff following these episodes. Half of Bella's pure mand initiations incurred consequences that *matched* ($n = 2$, 33.33%) or *may match* ($n = 1$, 16.67%), and the other half of her initiations included consequences that were assessed as no functionally appropriate match ($n = 3$). Consequences following pure mand initiations by Bella that were assessed as no match were *attention or praise* alone or instances of *no reply* by staff.

Consequences following mand-tact communicative episodes.

In total, student initiations with staff that were coded as mand and tact combination ($n = 51$) received consequences that were coded within 10 categories. The consequences of most mand and tact based episodes ($n = 34$, 66.67%) were assessed as *no match* to the function. Fewer mand and tact based episodes were assessed as a *match* ($n = 11$) or *may match* ($n = 6$), and accounted for the remaining third (33.33%) of mand and tact combined initiations. Most often the consequences assessed as functionally appropriate matches were *attention or praise* combined with *help or assistance* ($n = 5$) and *help or assistance* alone ($n = 4$). Initiations coded as inappropriate (no match) were those that incurred consequences of *attention or praise* alone ($n = 8$), *correction* alone ($n = 9$), or *reprimand* alone ($n = 5$), and all *no responses* ($n = 12$) from staff were assessed as inappropriate matches to student initiations.

Bella emitted the majority ($n = 44$, 86.27%) of initiations coded as mand and tact combined, and she most often encountered consequences that were assessed as *no match* ($n = 32$, 72.73%), in comparison to consequences assessed as *matches* ($n = 8$, 18.18%) or *may match* ($n = 4$). Most ($n = 12$, 37.50%) of the consequences following mand and tact initiations by Bella that were assessed as inappropriate were instances of *no response* from staff. When Deedee was observed initiating towards staff during episodes coded as mand and tact combined ($n = 4$), staff were observed providing consequences of *correction* alone (no

match) on two (50.00%) occasions, and Deedee received consequences that were assessed as *matches* (*attention or praise* combined with *escape from activity or assistance*) following her remaining two initiations. All observed initiations towards staff by Sophie were classified as mand and tact combinations ($n = 3$) and all incurred responses by staff that were assessed as either *matches* (*attention or praise* combined with *help or assistance*) or *may match* (*attention or praise* and *correction*).

Consequences following pure tact communicative episodes.

Consequences that followed initiations with staff that were coded as pure tacts ($n = 37$) were coded within four categories, and were assessed as *matches* ($n = 21$, 56.76%) or *may match* ($n = 7$, 18.92%) in the majority (75.68%) of episodes. In contrast, fewer pure tact initiations ($n = 9$, 24.32%) were followed by consequences assessed as *no match*. Bella initiated the majority of pure tacts ($n = 28$, 75.68%), and the consequences most frequently observed were *attention or praise* alone ($n = 15$, 53.57%) which were assessed as appropriate *matches* to the function. Staff were observed responding to student initiations with consequences coded as *attention or praise* combined with *correction*, and with *correction* only which were assessed as *may match* ($n = 6$, 21.43%), whereas staff were not observed providing a response following 25% ($n = 7$) of pure tact initiations with Bella. The remaining pure tacts were initiations observed with Deedee ($n = 9$), the consequences that most often followed were *attention or praise* alone ($n = 6$, 66.67%) and *attention or praise* combined with *correction* ($n = 1$) that were assessed as functionally appropriate *matches* or *may match*. Staff were not observed providing a response to two of pure tact initiations with Deedee that were assessed as *no match* (inappropriate) to the function.

Discussion

For individuals who are experiencing communication difficulties, developing and maintaining an effective repertoire of functional communication skills is a key learning and educational goal, potentially leading to socially significant outcomes. The overarching aim of this research was to determine the nature and extent of the naturally occurring communicative episodes observed with three high school students who had communication goals in their IEP that included use of AAC systems, within a New Zealand special education high school routine, from a verbal behaviour perspective.

To assess to what extent the environments facilitated the development and practice of functional communication skills, students were directly observed over 18 total hours across 432 total communicative episodes. During approximately three-quarters of the total communicative episodes when the communication partner was a staff participant, details of their behaviour (prompts and responses provided to students) were also documented.

The communicative episodes described within this behavioural investigation of effective functional communication skills within a New Zealand special education high school adds to the communication intervention literature in several ways. In particular, this research adds a unique verbal behaviour insight that aimed to address two integral meta-questions.

What Evidence Was Observed that Students Used Communication Skills Functionally?

A general discussion related to the observed communicative episodes with students in this study in comparison to previous studies, and a verbal behavioural oriented discussion related to the evidence that students communicated appropriately and functionally, follows.

Rates and types of communicative episodes.

Before considering whether students used communication skills functionally, the first variables documented in this study (rates and types of communicative episodes per hour)

were documented to establish if students had purposefully used communication skills. Evidence from the current study showed that all three students were observed during communicative episodes at an average rate of approximately 25 per hour (summarised in Table 1), but that each student was involved in episodes that occurred at very different rates. In comparison to rates found in prior observations, communicative episodes in the current study were observed at a slightly higher overall mean rate than was found with participants in one study (Andzik et al. (2016) reported 19 communication acts per hour) but at a much lower hourly rate overall than with students in another study (51 acts per hour found by Drain and Engelhardt (2013)). Rates of communicative episodes in this study were also lower than the estimated rates for the focus students in two studies by Chung and colleagues (69 acts per hour in Chung and others (2012) study, and 30 acts per hour in Chung and others (2019) including an estimated 40 per hour by peer comparison students).

Opportunities to respond (approximately 15 episodes per hour) accounted for nearly two-thirds of the total communicative episodes observed with students in the present study, and were observed most frequently and at the highest mean rate with Deedee. The findings from this study varied when compared to the average rates and proportions of opportunities to respond found in prior studies. The proportion of response opportunities encountered by students in the current study was larger than those observed in prior studies (Chung et al., 2019; Drain & Engelhardt, 2013) but was smaller than the proportion of response opportunities found in (Andzik et al., 2016; Chung et al., 2012). The mean rate of opportunities to respond per hour observed in the current study was less than half the rate reported in one earlier study (31 acts per hour by Drain and Engelhardt (2013)) and was a much lower than the estimated rate of 60 response opportunities per hour in Chung and others' (2012) study. The rate of opportunities for students to respond found in the present study was more similar to the rate of response opportunities in some earlier works. Students

in one study were observed during approximately 17 opportunities to respond per hour (Andzik et al., 2016), and in the research by Chung et al. (2019) both focus students and the typically developing peer comparison students were observed during the same average of 24 per hour. High rates of opportunities to respond found in the current study indicated that students were actively provided with opportunities to communicate and were therefore provided with learning opportunities that may facilitate students using communicative responding skills. Problematic to students experiencing high rates of opportunities to respond, or only demonstrating responding skills, is that students may become dependent on prompts to communicate (Bondy & Frost, 2001; Frost & Bondy, 2002; Rämä, Kontu, & Pirttimaa, 2014), and reliance on prompts was something that was noted as a concern in Deedee's most recent IEP. Given the potential for individuals to develop prompt dependency, inclusion of strategies designed to teach communication skills by prompting students but also includes eliminating the use of prompts to teach initiation (Bondy & Frost, 2001; Frost & Bondy, 2002; Sundberg, 2014b), could be considered necessary and more effective.

Student initiations observed in the current investigation accounted for approximately one-third of the total communicative episodes, and were observed at an average rate of approximately 10 per hour. Analyses of student initiations observed in the current investigation revealed the largest variance ($SD = 67.80$ initiations) and divergence (range = 4-129 initiations) between participants. This variability in initiations was largely due to Bella emitting the bulk of initiations at a much higher rate per hour than were observed with Deedee and Sophie. In comparison with earlier investigations, the proportion of student initiated episodes observed in the current study was greater than what was observed in some studies (10% in Andzik and others (2016) and 15% in Chung et al. (2012)), but smaller than the 41% of initiations observed with participants in Drain and Engelhardt (2013). The average rate of initiations observed in this study was also lower than what was found in

another prior study (Drain & Engelhardt, 2013) but was higher than rates of just over two per hour in Andzik et al. (2016) and almost 9 per hour in Chung et al. (2012). A much larger proportion of student initiations were observed in the present study when compared with participants with disabilities (18%) included in the work by Chung et al. (2019). However, initiations by students in the present study were observed in a comparable proportion to the number of initiations emitted by the typically developing peer comparison students (32%) during the same study (Chung et al., 2019). In contrast, the mean rate of student initiations observed in the current study was half the rate of those observed with peer comparison students (20 per hour) but was similar to the rate found with the students with disabilities (11 per hour) in the project by Chung et al. (2019).

Possible explanations for the variations in rates and types of communicative episodes found with students in the present study compared to prior findings could be variations in the total length of observation times, the environments where observations were conducted and the associated structures and cultures of each setting, or the variations in how communicative episodes were defined.

In the present research, students were observed for approximately five hours each, similar to Andzik et al. (2016), whereas other studies conducted observations over much less total time (Chung et al., 2012; Chung et al., 2019; Drain & Engelhardt, 2013). Shorter observation times may have been subject to observer reactivity resulting in high rates of communication than might not have otherwise been observed nor sustained over time. In addition, for both studies by Chung and colleagues (2012; 2019) the rates per hour were estimated from their reported interval data so may not reflect actual rates.

Another possible explanation is the diversity of environments where observations were conducted in the present and prior studies in terms of structure and culture and the communication exchanges observed were dependent on context. Some environments may not

facilitate high rates of communicative episodes (particularly initiations) such as those where communication acts during academic lessons may be seen by some as disruptive and as a cost to other learning and on-task behaviours (Drain & Engelhardt, 2013; Sundberg & Michael, 2001). The basic premise is that students do not need to communicate if there is no need to do so, and if this was true, we should see evidence of variations in communicative episode types and rates across settings. The unique inclusion of community-based observations in the present investigation produced results that supported the idea that the use of communication skills is dependent on the environment and context. Findings from observations within community settings showed that the rates and types of communicative episodes observed with all participants varied when compared to observations conducted within school-based settings (Figure 3.). Staff were observed regularly asking Bella questions about safety that may explain the increased rate of opportunities to respond observed with Bella during community-based observations. Similarly, more naturally occurring environments may explain the increase in initiations observed with Sophie within community-based settings compared to school settings. This is suggestive that more natural (or less structured) environments may facilitate more frequent student initiations in comparison to more structured settings that tend to be compensatory communicative environments (Andzik et al., 2016; Drain & Engelhardt, 2013; Light & McNaughton, 2014; Muharib & Alzrayer, 2018; Rămă et al., 2014).

Various and inconsistent operational definitions in prior observational studies were used to describe whether communication acts were student responses or initiations, including one study where a four-level model of spontaneity was utilised (Drain & Engelhardt, 2013), which may explain variations in types and rates of communicative episodes observed. Classroom cultures often include comments and instructions that do not necessitate communicative responses from students. These types of comments and instructions were not

recorded as communicative episodes in this study nor in the study by Andzik and associates (2016) and similar rates communication rates were found. Whereas some studies with very high rates (Chung et al., 2012; Chung et al., 2019) did document these types of communicative acts as part of the overall rates reported. None of the previous works included here documented these critical antecedent conditions in a way that was consistent with a verbal behavioural analysis, so making comparisons between studies is limited.

Heterogeneity of participants was noted as an area of concern within prior communication intervention literature (Brady et al., 2016; Tager-Flusberg & Kasari, 2013). Data showing the individual variability found in the present investigation, coupled with similar heterogeneity between participants also found in prior works (Andzik et al., 2016; Chung et al., 2012; Chung et al., 2019; Drain & Engelhardt, 2013), does not lend itself to making general statements and meaningful comparisons with other studies. However, the comparisons made between the rates and types of communicative episodes in the present and prior studies did offer some support to previous claims that the communication skills needs of individuals with disabilities are diverse (Brady et al., 2016; Sigafoos & Gevarter, 2019; Tager-Flusberg et al., 2017; Trembath et al., 2019). Communication interventions (and AAC systems) investigated are equally as varied, and not all that are effective with some participants may be equally as effective nor suitable for all learners (Bondy, 2019; Brady et al., 2016; Ganz et al., 2017; Ronski & Sevcik, 2018; Sigafoos & Gevarter, 2019; Trembath et al., 2019). Further, when examining ratios of students' communicative responses compared to initiations, whether students initiated or responded during communicative exchanges appears less important from a verbal behavioural perspective, than under what environmental conditions students communicated ergo whether or not students are able to respond and initiate when they were supposed to. As Bondy (2019) noted, we all experience opportunities to respond as part of typical communicative exchanges (such as when someone asks *how are*

you?) and initiations in these situations would not be appropriate (such as saying *I'm fine thanks* as an initiation towards someone). The inclusion of typically developing peer comparison students in the study by Chung et al. (2019) highlighted that, although lower overall rates of communication acts were observed with students with disabilities, both groups of students in their study were observed responding more often than they initiated and some focus students initiated more often than their peer comparison. Therefore, from a verbal behavioural perspective the proportion and rate of responding and initiating by individuals may not necessarily be as important indicator of deficits and mastery of functional communication skills compared to whether students are able to respond and initiate in functionally appropriate ways in line with typical patterns of responding and initiating.

The critical importance of learners developing initiation skills towards attaining independence and the ability to self-advocate has been previously emphasised (Andzik et al., 2016; Bondy, 2019; Sundberg & Partington, 2013). A single opportunity to initiate was captured in the current study that equated to an overall mean rate of less than one per hour. Only one previous study (Andzik et al., 2016) included communication acts that were coded as opportunities for students to initiate, and no initiation opportunities were observed with participants in their study. Similarly, only one opportunity to initiate was observed in the present study when Sophie was observed receiving a food item that required assistance to open, and was observed initiating a communicative episode in response. Requesting assistance is an important communication skill with a mand function that, like all initiations, are crucial to being able to communicate needs and wants to effectively and appropriately function within everyday routines (Skinner, 1957; Sundberg, 2014b; Sundberg & Partington, 2013). The research notes from this study, and those highlighted by Andzik et al. (2016), collectively provided some anecdotal evidence that may explain the few opportunities to initiate that were observed. Some communicative episodes in both studies met only part of

the definition of an opportunity to initiate (deliberately sabotaged some aspect of the communicative environment in a bid to elicit a communicative initiation) but were missing the necessary five second wait following the sabotage attempt.

In spite of the lack of observed opportunities to initiate, all participants in this study initiated some communicative episodes. Findings for Deedee and Sophie, the two students in this study who initiated the least and at the lowest rates, somewhat supported and were consistent with all prior observational studies (Andzik et al., 2016; Chung et al., 2012; Chung et al., 2019; Drain & Engelhardt, 2013) that found most students were able to initiate, albeit at low rates. Two communicative episodes with Deedee and Sophie serve as excellent examples to discuss initiations. The first student initiation example occurred with Sophie during a community-based observation where lunch was served to other diners before Sophie received her meal, which could be described as a naturally occurring opportunity to initiate (but not deliberate so was not coded as an opportunity to initiate). During this episode, Sophie initiated in a bid to gain access to a meal. The second initiation example occurred during a non-academic (morning tea) setting with Deedee. During this observation session, the observer was present (and sitting at the same table as Deedee) but because the observer was conducting unobtrusive observations, this inadvertently created an opportunity for Deedee to initiate. As part of the methodology of this study, observers avoided speaking with students but did smile to students who attended to them during observation sessions. In lieu of not speaking, but being present as a potential communication partner, the observer effectively created a time-delay sabotage to the communicative environment. In response, Deedee was observed initiating communicative episodes directed towards the observer about what food items she had for morning tea. These are important observations from a verbal behavioural perspective, particularly in relation to Deedee and Sophie, because they indicated that even without deliberate attempts to sabotage the communicative environment Deedee

and Sophie were able to initiate communicative episodes when necessitated by naturally occurring (or inadvertently created) initiation opportunities. These initiation examples also support the idea that the provision of many opportunities to respond may be counterproductive if the learning aim is to encourage student initiations. Deliberate efforts, and attention to teaching strategies, that are designed to provide more opportunities for students to initiate in response to naturally occurring environmental stimuli (rather than responding to prompts from communication partners) could therefore be described as providing more facilitative environments (Andzik et al., 2016; Frost & Bondy, 2002; Muharib & Alzrayer, 2018; Rämä et al., 2014; Sundberg & Partington, 2013). In line with previous research that highlighted individuals with developmental disabilities tended to play mostly passive roles during communication interactions (responding more than they initiate), another potential learning and educational implication might be to adapt some opportunities to respond into opportunities for students to practice initiation skills. For example, response opportunities provided to students may easily be changed to initiation opportunities by simply adding a wait of at least five seconds. In light of the importance of acquiring mand based communication skills (Bondy & Frost, 2001; Skinner, 1957; Sundberg, 2014b; Sundberg & Michael, 2001), the inclusion of teaching strategies to encourage the development of mand repertoires within communication interventions is suggested. This is especially important for populations that are of high-school age or older where the use of some techniques specific to teaching mands are not regularly (Drain & Engelhardt, 2013) or correctly utilised (Tager-Flusberg et al., 2017). Future research to refine the operational definition of deliberate sabotage attempts as opportunities to initiate, and to ascertain the efficacy of various sabotage strategies on the rates of student initiations is encouraged.

Communication modes, the availability of aided systems, and frequency of communicative episodes when students had access to aided systems.

The next set of descriptive variables documented in this study were to address if the communication skills used by students were functional.

Communication mode

Although the type of communication mode is irrelevant (albeit necessary to make a communicative exchange) in ascertaining the functionality of communication skills within a verbal behavioural account, the communication modes used by students in this study were documented. Communication modes used by students were captured as part of this study because AAC systems are commonly introduced as part of overall communication interventions so establishing if students used AAC systems, and if use of AAC systems improved the quality of their communication skills, was relevant to the aims of this study.

The most frequently observed communication modes used by Bella and Deedee were vocals in the majority of episodes followed by gestures and no responses, and least frequently observed were use of AAC systems (aided and unaided) and unwanted behaviours. The results of communication mode used most often with Bella and Deedee in the current study, followed the same pattern of modes that were most and least frequently used by students in earlier works (Chung et al., 2012; Drain & Engelhardt, 2013), and were consistent with the modes most often used by both participants with disabilities and by the typically developing peer comparisons included in Chung et al. (2019). This did not hold true for Sophie who was most often observed using gestures, no response, aided AAC systems, and other unwanted behaviours (for example, squealing and grabbing at items). Findings of Sophie being observed using gestures and AAC systems more frequently than other communicative modalities were instead similar to the modes most often used by participants in three previous studies. Similar to Sophie, participants were previously observed using mostly gestures (coded as also including sign language) and using aided AAC systems at similar rates (Chung et al., 2012; Drain & Engelhardt, 2013). Participants in one prior study (Andzik et al., 2016)

were observed using aided systems during the majority of communication acts. However, neither Deedee nor Sophie (both students in this study who used aided systems) were observed using aided systems as a communication mode as frequently or at similarly high rates as some previous participants (approximately 9% in the current study, compared to 63%, at rates of just over three per hour, in Andzik's (2016) study). Use of manual signs (unaided AAC system) in the current investigation was also rarely observed (less than 5%), this finding was similar to students' use of sign language in Chung and other's (2012) study but was approximately half the amount used by students in (Andzik et al., 2016). These findings highlighted that, for students like Sophie who showed evidence of less developed vocal skills so may be totally dependent on AAC systems as an alternative to natural speech, there is greater urgency in distinguishing the suitability of AAC systems implemented with learners and them using these systems functionally within their everyday settings (Bondy, 2019; Trembath et al., 2019).

Participants in prior studies were observed using multiple communication modes at the same time, including an average of four modes per communication act by some participants (Chung et al., 2012), similarly students in this study were also observed regularly using combinations of modes during a single communicative episode. Sophie was observed repeatedly using a specific combination of three modes: manual sign (usually the sign for *please*) and gesture (usually nodding), together with either vocals (usually *pls*, a vocalised approximation of *please*) or pointing to a picture on the low-tech communication board. During a community-based observation session with Sophie when no aided AAC system was available, several communicative episodes observed with Sophie were coded as use of gestures. Additional research field notes highlighted that during these episodes Sophie used two types of gestures: she was observed nodding and tapping her finger in the same manner as she would to use the low-tech communication board despite it not being in front of her. An

aided AAC system was not present on this occasion so this behaviour was coded as gestural, whereas pointing when an aided system was present during other episodes was coded as students' use of high or low-tech systems that may present as misleading evidence that aided AAC systems were 'used' to communicate. What these observations with Sophie highlighted is that, from a verbal behaviour perspective, it could be that Sophie has learned to produce a group of communicative behaviours (and is able to use these behaviours functionally as a set) as opposed to having learned various expressions of the same response that are simply via different communicative modalities. This finding also highlighted the importance of conducting single case and descriptive investigations of students' use of communication skills (like was conducted in the present study) to allow for results that reflect these important findings that are not highlighted within studies using quantitative measures alone. In general, communication modes used by students in this study were observed in similar patterns and proportions of communication modes observed in earlier studies, including peer comparison students in Chung and other's (2019) study. These findings serve as a reminder that when determining communication skill goals and suitable mastery criteria for students, that speech alone does not necessarily have to be the objective. These findings also highlighted that the aided AAC system was not always available for students who appeared to need it.

All three students in this study were observed producing no response during approximately 13% of the opportunities to respond they encountered, including during 10% of episodes with staff participants when they had provided additional prompting. No response to an opportunity to respond was primarily observed with Sophie (22% of the total opportunities to respond she experienced) and were observed at approximately twice the rate of no responses with Deedee and Bella (approximately 10% each). During the majority of episodes where Deedee and Sophie were not observed responding there was an aided AAC system available to them. This finding suggested that for the students with the least well-

developed communication skills, particularly for Sophie who showed limited use of speech, the AAC systems in the present study did not adequately compensate. Instances of no response by students in current study were observed with staff much less frequently than was found in prior studies (approximately 55% in both Chung et al. (2012) and Andzik et al. (2016) studies, and 38% in Drain). Communicative episodes where students were not observed responding may represent missed opportunities for students to learn functional communication skills. Lower instances of no student response found in this study compared to higher rates in prior studies may be explained by the students in this study all being over 16 years so they may have learned some communication skills that work functionally such as the gestural responses observed (for example, nodding or thumbs up gesture). A possible explanation for students not responding may be that the student was not attending to the communication partner at the time the opportunity to respond was delivered, or that students did not hear the response opportunity, or students were unaware a communicative response was required. Some communicative episodes in this study (particularly those with a large number of prompts) were instances of staff reframing questions in ways that necessitated similar but different answers and sometimes specific answers only (for example, stopping part way through a sentence to elicit a specific answer). Staff were also observed repeating questions to students rapidly and not giving students time to formulate their response which was also found in the study by Andzik and others (2016).

Access to aided AAC systems and communication when aided AAC systems were available

All students with aided AAC systems (Deedee and Sophie) in this study had at least one aided system available to them during almost 70% of their combined communicative episodes. In the present study, on average, no aided system was available for students to use during almost a third of the total opportunities to respond and during less than 4% of student

initiations observed. Students in the present study were observed with no access to an aided AAC system during fewer communicative episodes than instances of students not having access to aided systems previously reported (Andzik et al., 2016; Chung et al., 2012). Students in current study were observed with access to aided systems during approximately 10-20% more communicative episodes than earlier studies (Andzik et al., 2016; Chung et al., 2012). The relatively high availability of aided systems for students in the present study may be indicative of staff actively ensuring aided AAC systems are available, but there remains room for improvement towards ensuring students have constant access to aided AAC systems as recommended (Frost & Bondy, 2002).

Analyses of whether students in this study communicated more frequently when aided systems were present compared to when aided systems were not available revealed that communicative episodes (both opportunities to respond and student initiations) with Deedee and Sophie occurred more frequently, and at higher rates, when aided systems were available. A possible explanation for this finding is the presence of the aided AAC system itself. Alternatively, the higher rates of communicative episodes may have resulted from staff having focussed on communication during lessons when aided AAC systems were present as evidenced by the findings that staff in the current study regularly modelling use of AAC systems during opportunities to respond they presented which supports the latter conjecture. The finding that communication episodes occurred at higher rates when aided AAC systems were available compared to when they were not may be misleading in terms of assessing the functionality of students' communication skills that occurred when aided systems were present, particularly via aided systems. In total, student participants utilised an aided AAC system as their communication mode during approximately 15% of the total instances where an aided AAC system was available to them. Little evidence of students in this study using aided systems independently to respond or to initiate communicative episodes was observed,

which does not support the higher rates of communicative episodes observed just being due to the presence of aided systems. In addition, when students were observed using aided systems the episodes were most often opportunities to respond prompted by staff participants modelling the aided system (captured in this study as echoic responses via aided AAC systems), but were rarely instances of students initiating via aided AAC systems. Deedee was the only student during the entire study who was observed initiating via an aided communication system and only did so approximately five times, and these were always accompanied by vocals. Additional research notes from this study highlighted that staff were predominantly in control of the aided systems, which was presumably to model the use of these systems. After demonstrating the use of aided AAC systems staff were observed presenting the aided system to students to respond, but staff typically retained physical possession of the system. Students tended to only be in possession of the aided systems when asked to carry them during transitions. Given that staff in this study were observed presenting more of these opportunities to respond with aided systems than students were observed independently using the aided systems, and that staff were most often in possession of the system itself, staff participants could be described as having used the aided AAC systems more often than students did.

Overall, communication mode findings from the current study further support the notion made earlier that not all students were observed using their communication skills functionally despite having an aided AAC system provided and available (Ronski et al., 2015; Smith et al., 2020; Tager-Flusberg & Kasari, 2013). This explanation is supported by a verbal behavioural perspective, and is further suggestive that some aided AAC systems may not be suitable for the heterogeneity of participants noted earlier. Some aided AAC systems (including learning and teaching strategies) may be designed specifically for people with an impaired ability to use speech but are not necessarily suitable to meet the needs of those with

impaired communication skills. Future research in regards to the efficacy of the specific components of AAC systems including the mode (high or low-tech based pictures or manual sign) and specifics of the associated learning and teaching strategies is needed. Future research to inform how best to support to independent communication skills should also include specifically how to define what is meant when an aided AAC system is said to have been ‘used’ by individuals. A necessary question to address in any determination of aided AAC system intended to support functional communication skills, is whether pointing to an AAC systems served the same function as exchanging a picture (as per the PECS procedure). This is particularly important to consider in light of finding from the current study that revealed the same response of pointing was used during mand, tact, echoic, and intraverbal responses.

Findings that students in this study used aided AAC systems less frequently than participants in the study by Andzik et al. (2016) may be because all participants in their study had aided AAC systems. The varied frequency of use of aided AAC systems found in this study compared to others may also be explained by varying levels of need by students to use alternate modes, student and staff aided AAC system experience, and the emphasis placed on use of aided systems. Both types of aided systems in this study had recently (within one year at the time of observations) been introduced, but details of student and staff experience or training in the used of aided AAC systems was unknown.

It was not a surprising finding that Bella did not use an aided AAC system as this aligned with her IEP, but it was surprising that Bella only used manual signs once and that Sophie and Deedee were observed using signs is also consistent with both of their IEPs goals. Nevertheless, the low rate of use of manual signs observed during the current study was incongruent with the IEP goals all three students’ to frequently use sign language to communicate. It should be noted that the inclusion of sign language as a separate category in

this study was limited because the observers in this study were not fluent in New Zealand sign language. As a result, the minimal use of sign observed in this study may be explained by observers having missed some manual signs and mistakenly coded these as gestures, or that observers may have only been able to code the few commonly used manual signs they were aware were used within the school where observations were conducted. To account for this limitation a secondary analyses of gesture combined with sign (as was done in previous studies) was calculated, but revealed that sign and gesture combined still only accounted for just over 20% of the total communicative episodes observed in this study.

Low frequencies of students' use of aided AAC systems has been explained by some as being due to limited access to aided systems (Chung et al., 2012; Drain & Engelhardt, 2013; Light & McNaughton, 2014), whereas a higher proportion of access to aided systems was found in (Andzik et al., 2016). Findings that students in the current study did not have continuous free access to aided AAC systems somewhat supported the notion that a lack of access to a system is problematic for those relying on these systems to communicate. But the suggestion that students' use of aided systems may be limited due to lack of device availability also implies that those students who needed an alternative mode to communicate would have used the aided system if it was present, examples from this study where an aided AAC system was present but not used, refute this claim. It logically follows that if an AAC system was available to use and students who did not use vocals did not use the aided system to communicate, that aided systems on these occasions did not add to the quality of communication skills for students even though higher rates of communicative episodes occurred when aided AAC systems were present. Low use of aided systems and comparatively higher rates of use of gestures and manual signs has been explained by some authors who speculated that participants' use of these modes showed preference for what these authors described as less complex communication modes over more complex AAC

systems and manual sign (Drain & Engelhardt, 2013). The possibility that students' use of AAC systems may also be affected by the severity of their cognitive and/or concomitant physical disability limiting students' ability to use AAC systems compared to utilising other communication modes should also be considered. While these may all be factors, a limitation of this study was that students' physical disabilities and communication skills were not formally assessed. Further research is needed to ascertain the barriers and challenges to different AAC systems especially for adolescent and adult users (Bondy, 2019; Holyfield et al., 2017) that is beyond the scope of this study.

Sophie was observed using communication modes coded as unwanted (such as squealing and grabbing at other diners' plates) during all of her observed initiations, but Sophie did not use the aided system that was present during all these episodes. It should be noted that these behaviours might have become somewhat functional for Sophie evidenced by these initiations being observed to successfully achieve the desired outcome. Problematic from a verbal behaviour perspective in relation to the functionality of unwanted communication modes is that these skills are adaptive only in terms of producing the desired outcome. These skills are not adaptive in the sense that they are generally considered inappropriate ways of behaving that may therefore be associated with undesirable outcomes for the student. Unfamiliar listeners would not necessarily be able to interpret what squeals meant (a similar issue can occur with use of sign language) and grabbing at others' meals is generally not acceptable so may result in the student being reprimanded or isolated. The importance of students being able to communicate in an appropriate and effective communication mode within these naturally occurring contexts is vital.

Evidence of primary verbal operants.

Showing evidence of responding and initiating during communicative episodes, and using effective and acceptable communication modes (no matter the form), are not

necessarily sufficient variables to determine if students are able to effectively communicate. Individuals with impaired communication skills might not be able to use the communication skills they do have for a specific purpose. Therefore, it is vital to describe whether students used any of the four primary verbal operants as part of the overall evidence of students using their communication skills functionally.

Overall, all students in the present study were observed showing some evidence of the four primary verbal operants, but two students (Deedee and Sophie) to varying degrees and with functional limits. Examination of the evidence of the four primary verbal operants revealed that tact (65%) and intraverbal (55%) functions were assigned to the majority of communicative episodes, followed by mands (37%), and the echoic (19%) was least frequently coded. Because no prior observational studies were found that described the function of the communication acts they observed in terms of verbal operants, the extent to which comparisons between prior findings and results from this study can be made is limited. This is especially true of studies where insufficient detail of the communication acts observed is provided rendering comparison impossible in some cases (Tincani et al., 2020). In order to ascertain if students were able to engage in a range of communicative exchanges it is important for people to learn and be able demonstrate the use of mands, tacts, intraverbal, and the echoic responses to show evidence of a robust communication skill repertoire (Bondy, 2019).

Two prior studies described the function of the communication acts they observed (Chung et al., 2012; Drain & Engelhardt, 2013) but not in enough detail to directly compare with the results of this study, but do enable some theoretical discussion of the functional findings in this study in comparison to earlier works. The codes of comment, ask questions, wants, and transfer of information used by Chung et al. (2012) may all have possible tact functions. Codes of instructions, asking questions, wants, social closeness and etiquette, and

transfer of information (Chung et al., 2012) could all contain aspects of mand functions. All opportunities for students to respond captured in prior studies (Chung et al., 2012; Drain & Engelhardt, 2013) by definition would likely have been at least part intraverbal. All three codes used by Drain and Engelhardt (2013) were too generally specified to assume any functional similarities with verbal operants. These results illustrate the importance of interdisciplinary work (Bondy, 2019; Cardon, 2017; Donaldson & Stahmer, 2014; LeBlanc et al., 2006; Tager-Flusberg et al., 2017) that would enable comparison of findings and may potentially lead to creating positive communicative behaviour change with individuals experiencing impaired communication skills.

Due to the observations in this research being conducted within naturalistic routines, as expected (Michael et al., 2011; Pierce & Cheney, 2017; Skinner, 1957), for all students the majority of communicative episodes observed were coded as being multiply controlled (a combination of functional codes were applied) and pure functions (single functional codes) were less frequently observed. All students were observed in communicative episodes coded as pure intraverbal, but not pure tacts (Bella and Deedee only), pure mand (Bella only), or pure echoic (Deedee only), and the most common combination was mand and tact combined.

Further analyses of functional codes assigned to student initiations (recall by definition only mand, mand and tact, or tact alone functions are possible for student initiated episodes) showed that the most commonly applied function was tact in approximately 96% of episodes followed by mand (64%). The high proportion of tact evidence observed in this study makes sense given part of the definition of a tact operant is to comment on or report on the presence of the stimuli in the students' immediate environment that are salient to the students at the time of the communicative episodes. The mand episodes observed in this study indicated that students made requests or rejections during approximately two thirds of initiations, which is consistent with previous research that indicated most communicative

exchanges tended to be request (mand-based) (Alzrayer et al., 2020; Aydin & Diken, 2020; Ganz et al., 2017; Gilroy et al., 2017; Logan et al., 2017; Lorah & Parnell, 2017; Morin et al., 2018; Tincani et al., 2020). The single opportunity to initiate observed with Sophie was coded as a mand, which reflected that the state of deprivation (the need for help or assistance with the food item that was required) occasioned this communication episode. This example also demonstrated that the purpose of the mand episode was for the student to gain the specific outcome of help from the communication partner in order to consume the wanted food item. Results from this study that approximately 90% of opportunities to respond observed were coded as intraverbal also makes sense by definition (recall intraverbal operants are responses to the verbal behaviour of others). Episodes of opportunities to respond coded with echoic functions (30%) reflected aspects of students imitating their communication partner. The function of mand assigned to 22% of opportunities to respond observed in this study may have represented the communication partner anticipating students' need and wants (Andzik et al., 2016) that could, as noted earlier, potentially undermine students' independence by creating prompt dependency. For example, if the opportunities to respond provided by communication partners result in students only learning to communicate what they want when asked (prompted to do so).

Individual analyses of the functional codes applied to communicative episodes revealed that Bella showed the most evidence of all four fundamental verbal operants including pure operants; the only exception was that Bella was observed during fewer episodes coded as echoic and was not observed during any pure echoic episodes. Evidence of pure mands was only observed with Bella. This finding indicated Bella was able to initiate when she needed to, and that she was observed independently requesting that a communication partner provide a specific item of food for a future lunch. Episodes with Bella accounted for most of the total mand episodes observed so, of the students in this study, Bella

showed the most evidence of a strong mand repertoire. Strong evidence of tact episodes was observed with Bella, including around one-third pure tacts, which showed evidence that Bella was able to label stimuli in her environment and comment to others. Intraverbal and echoic responses were the only operants less frequently observed with Bella (less than one third that observed with Deedee and a similar number to Sophie). However, observations of fewer intraverbal and echoic responding did not necessarily reveal limitations for Bella across these two operants. Bella was observed responding to opportunities to respond (intraverbal) so it is more likely fewer intraverbal responses observed simply means that Bella was asked questions less often than the other two participants were. In addition, given that Bella was frequently observed using speech it is unlikely that Bella was not able to emit echoic responses, but more likely that she was just not observed during pure echoic responding in this study or that individuals with more advanced verbal behaviour repertoires are less likely to emit echoic responses. Overall, descriptions of communicate episodes observed with Bella might be indicative that Bella's skill difficulties may be more social in nature.

Communicative episodes with Deedee showed some evidence of all four verbal operants, but only three pure forms (intraverbal, tact, and echoic) but no pure mands. In contrast to the strong mand evidence observed with Bella, low levels of mand episodes and no pure forms of mands were observed with Deedee and Sophie. This finding was indicative of less developed mand skills observed with Deedee and Sophie, which may be connected to the low levels of opportunities to initiate and compensatory environments found that limited the chances for students to practice these skills. Most episodes with Deedee were coded as intraverbal responses. An example of a pure intraverbal observed with Deedee was an episode where a staff participant asked, *how was swimming?* and Deedee replied *good, good*. However, this finding may not have been representative of Deedee using intraverbal skills functionally because research notes indicated that many of Deedee's intraverbal responses

tended to happen only following a limited number of commonly asked questions and with a limited number of intraverbal responses such as *yes/no*, *good*, or replying correctly when asked her name. These findings showed evidence of limitations to the intraverbal responding observed with Deedee. Results showed that during intraverbal episodes Deedee was regularly observed responding by imitating the vocalisations of others (echoic) and in response to being asked about her needs (mands). Two episodes from observations with Deedee serve as examples to demonstrate these critical limitations to the function of Deedee's intraverbal communication skills. The first example is an episode where Deedee's response was part echoic occurred when a staff participant asked about a prior event to which Deedee replied by repeating the name of the town. The second example was an episode where Deedee's intraverbal response was also coded as tact and echoic but represented another incorrect response, although tact operants observed with Deedee showed strong evidence that Deedee was able to name (and sometimes comment on) most things in her environment. During an observation where students had purchased their lunch a staff participant saw that Deedee had pulled all the fish out of the sushi she had chosen and asked *don't you like fish?*, and Deedee responded by saying fish. This example is also interesting because it highlighted potential limitations with Deedee's communication skills in terms of being able to effectively respond to questions related to her likes, and in selecting the meal wanted even though Deedee was observed independently responding to questions when ordering the sushi that included fish. As noted earlier, results from the present study serve to demonstrate the importance of investigations that provide thorough and detailed descriptions of the functional use of the communicative skills observed because quantitative descriptions alone may neglect to expose these functional limitations. Deedee showed the strongest evidence of echoic responding and was the only student observed emitting pure echoic operants. It is a strength that Deedee was observed imitating the verbal behaviour of others because this may serve as a good base to

build on the other types of operants and can be an adaptive skill. However, the concern over individuals showing evidence of frequent echoic responding is that echolalia will develop which leaves these echoic communication skills bound to the limited function of echoic responding, as the findings with Deedee indicated.

Observations with Sophie showed some evidence of all four verbal operants, but evidence of only a few instances of pure forms of intraverbal and no pure forms of the remaining three operants revealed substantial limitations. Like Deedee, approximately three quarters of episodes with Sophie were coded as intraverbal, which aligns with Deedee and Sophie encountering the majority of opportunities to respond observed. Only four pure intraverbal episodes were observed with Sophie that were all responses via gestural or vocal approximations but not intelligible speech, which suggested limitations to the functional of the intraverbal responding that was observed with Sophie. For example, when Sophie was asked, *what are you staring at, are you watching [name of peer's] food?* Although Sophie nodded, it remained unclear whether Sophie was simply responding with a general behavioural response that she had learned to produce when asked questions or whether the purpose of her response was actually to affirm that she was in fact watching her peer's food. In addition, episodes with Sophie coded as intraverbal and echoic were indicative of further limitations but they also showed some evidence of Sophie imitating the verbal behaviour of others. All of the combined intraverbal and echoic episodes observed with Sophie were restricted to the echoic function only and occurred via aided AAC systems (as opposed to vocal imitations). For example, Sophie was regularly observed being asked, *what would you like to eat?* and would respond by pointing to the same picture that represented *eat* on the aided communication system that the staff participant had pointed to. Finally, episodes with Sophie showed the least evidence of tacts including the fewest instances of intraverbal and tact combined. This finding indicated Sophie was infrequently observed labelling items or

commenting about her immediate environment when asked, and when Sophie did respond most occurrences were (like Deedee) also part echoic. While episodes with Sophie showed some responding (echoic and some intraverbal) that represented evidence of functional use of communication skills, it is unclear whether this type of responding showed evidence that Sophie was communicating for a purpose. It was also unclear whether the intraverbal responses observed with Sophie were truly accurate reflections of her needs (correct responses), so limitations in Sophie's ability to use her communication skills functionally were revealed.

Finally, the limited evidence of mands evidenced in episodes observed with Deedee and Sophie is most concerning from a verbal behavioural perspective. Deedee (approximately 20% of her episodes) and Sophie (approximately 43% of her episodes) both showed evidence of mands but in both cases fewer than half the mands emitted by Bella, and most often they were in response to opportunities to respond. No pure forms of mand operants were observed with Deedee or Sophie. Episodes coded as mands that were observed, were typically mand and intraverbal responses (such as responding to opportunities to respond provided by communication partners which are not defined as pure mands) or were partial mands (communicative attempts by Deedee and Sophie where the reinforcer was not specified). Partial mand episodes observed with Deedee or Sophie included instances when their communicative attempt only indicated *please* (or an approximation of please such as *pls*) or *help*, but did not specify what was being requested. For example, Deedee was observed handing her iPad® to a staff participant while saying *help, please*. The prior example of Sophie being observed emitting unwanted communicative behaviours in a bid to obtain her lunch is also an example of a partial mand. Partial mands are somewhat functional (because they are effective enough to provide a clue to the communication partner that something is wanted) but they are not particularly adaptive because the audience is left having to guess

what is being requested (or rejected). The findings that no evidence of pure mands revealed further limitations in the functional use of communication skills observed with Deedee and Sophie. It is more likely that the environments were arranged in a way that rendered communication unnecessary, than it is likely that over five total hours these two students only experienced needs or wants as infrequently as they were observed independently indicating. As previously noted, data from the current investigation (particularly results from observations with Deedee and Sophie) supported this notion. Staff were observed providing what appeared to be anticipatory offers to accommodate Deedee and Sophie's needs, for example, staff regularly delivered opportunities to respond such as asking, *do you want a [tangible item]*? From a verbal behavioural perspective, these opportunities to respond may be an indicator of unhelpful interactions in terms of promoting important independent (unprompted) communication skills.

Results for Deedee and Sophie may represent serious limitations to their capacity to have their basic needs and wants understood, specifically that they were not observed being able to use their communication skills to communicate about items, activities, or past and future events which are conversations that are an important aspect of forming and maintaining relationships with others. A possible educational implication from these findings might be to consider incorporating IEP goals designed to provide more deliberately contrived opportunities to initiate for Deedee and Sophie. Adaptations to the communicative environment may serve to provide students with optimal independent communication skill learning opportunities by capitalising on students' motivating operations and non-verbal stimuli (mimicking similar conditions to how spontaneously produced verbal behaviours are typically learned) in order to facilitate development of pure forms of mand and tacts.

Proportion of communicative episodes with adults or peers.

The final variable examined was to investigate the proportions of communicative episodes that involved adults versus peers. Determining whether students' communication skills generalise to various naturally occurring communication partners is, from a verbal behavioural perspective, another aspect of evidence that students are able to use their communication skills functionally.

Communicative episodes dominated by adult communication partners in this study (91%) was not a surprising finding, based on the results of previous studies where the majority of communication acts observed also occurred primarily with adults (Andzik et al., 2016; Drain & Engelhardt, 2013). Adults as the primary communication partner was also found in previous studies conducted within mainstream educational settings where typically developing peers were also present as potential communication partners (Chung et al., 2012; Chung et al., 2019). Communicative episodes with peers in the current study (approximately 12% of the total) were observed in a similar proportion to acts that included peers in Chung et al. (2012), but were observed almost three times as often as participants in the study by Andzik et al. (2016). Episodes with peers in present research were observed less than half as often as the students with disabilities in the study by Chung et al. (2019), and about quarter as often as the peer comparison students. Bella was the only student in the current study who was observed initiating towards peers, these initiations towards peers by Bella showed evidence of more peer-directed initiations than were observed in the study by Chung et al. (2012) (just over 5%). Initiations towards peers were observed in this study in similar frequencies to initiations observed with students with disabilities (10%) in Chung et al. (2019) but less than half as frequently as the initiations towards peers observed with typically developing peer comparison students. Findings that two students in this study (Deedee and Sophie) were never observed initiating towards peers is similar to previous studies where some participants were not observed initiating towards peers (Andzik et al., 2016; Chung et

al., 2019; Drain & Engelhardt, 2013). While communication primarily with adults within school settings might be somewhat expected, especially with students with disabilities who (depending on their individual level of need) tend to have support personnel in attendance. However, the importance of students also being able to use their communication skills to interact with peers (and forming friendships) cannot be overlooked. An obvious explanation of the lower proportion of communicative episodes with peers in this study compared to two of the prior studies (Chung et al., 2012; Chung et al., 2019) might be that both these studies were conducted exclusively within mainstream classrooms where a greater proportion of peers were present. However, Chung et al. (2019) reported that higher frequencies of communicative acts between students with disabilities and peers was correlated with less adult proximity, specifically the presence of support personnel. This was similar to other prior studies that found the presence of teacher aides served as barriers to interactions with typically developing peers (Anderson et al., 2004). However, while less communicative episodes with peers in this study in comparison to both groups of students in Chung et al. (2019) were observed, similar proportions of episodes with peers in this study and Chung et al. (2012) were found. It should be noted that mainstream peers were present during some observations that occurred within communal areas of the school in the current study, and that it was during these types of non-academic settings when Bella was observed wandering around initiating towards mainstream peers and that staff were close by but were not in Bella's immediate vicinity. That Bella, and the focus students with disabilities in Chung and colleagues (2019) study initiated towards peers in large proportions than they were observed responding, adds some insight into the potential for students with developmental disabilities to learn to initiate towards peers (including mainstream peers) if given the opportunities to do so. Within a verbal behavioural framework, showing evidence of communicating with a variety of people is an important functional aspect of students' use of communication skills,

but more importantly a vital aspect necessary to develop and maintain social relationships, including friendships.

In summary, results of this study showed communicative episodes were observed with all students and all students showed some evidence of using communication skills functionally, but to varying extents. Bella exhibited more evidence of using communication skills functionally across all of the variables measured, while findings with Deedee and Sophie revealed some limitations across different variables in terms of function of the communication skills they were observed using. That Deedee and Sophie showed the least evidence of using communication skills functionally provided some evidence that, for these two students, their communicative environment may have been compensatory to, rather than facilitative of, developing and practicing certain aspects of functional communication skills.

What Evidence of Staff Prompts for Students to Communicate was Observed, and to What Extent Could Staff Responses Following Student Initiations be Described as Functionally Appropriate Matches?

The final set of variables included in this study were to address the second meta-question of what evidence of staff prompts for students to communicate was observed, and to what extent staff responses following student initiations could be described as functionally appropriate matches.

Prompt frequency and type provided by staff.

The first set of variables under this question were to describe how frequently prompts were delivered by staff, and what type of prompts were used, to elicit communicative responses from students. Results from the current investigation revealed evidence that staff provided additional prompts during almost 60% of episodes, which was more frequently than during 45% of communication acts observed in earlier work by Andzik et al. (2016). Staff in this study were also observed providing students with multiple prompts per episode, similar

to previous findings of between 1-25 prompts per communication act and an average of just under 2 additional prompts per episode (Andzik et al., 2016).

The most frequently observed type of prompt delivered by staff was modelling the use of aided AAC systems during approximately 51% of episodes with additional prompts. Followed by vocal prompts, then gestural type prompts (pointing to words, objects, or aided AAC systems to prompt students to respond). Findings of prompts type from this study align with one prior observation by Drain and Engelhardt (2013), who utilised a four-level model of communication spontaneity to determine various levels of prompting based on the type, and found staff provided direct (vocal and gestural) prompts significantly more often than other types of prompts.

Observations of staff prompting students to communicate by using aided AAC systems to demonstrate their own use of the aided system to communicate (primarily observed with Sophie but also with Deedee) did not align with a behavioural understanding of modelling strategies. The same observation with Sophie at lunch used in prior examples, aids in explaining this point. Opportunities to respond also occurred alongside Sophie's initiations to obtain her meal, and were instances of staff pointing to pictures on a communication board to model the communication they were also vocalising. For example, staff pointed to the *wait* picture as they vocally stated that Sophie needed to wait for her meal to arrive. Problematic, from a verbal behaviour perspective, is that the modelling of aided system use did not provide a model of the expected target behaviour for the student to imitate. A model of a specific response (student target behaviour) might instead be using the aided systems to demonstrate the message, *I want lunch* or possibly, *I don't want to wait*. Findings that described the way staff used aided AAC systems to prompt students revealed evidence of structural (expressive and receptive communication) based approaches to learning and teaching communication skills as having influenced the way modelling

strategies were employed in this study. Structural methods such as augmented language input and use of modelling techniques are incongruent with behavioural modelling techniques and strategies effective in teaching students communication skills and how to use aided communications systems (Horton, 2020; Tager-Flusberg et al., 2017; Tincani et al., 2020; Trembath et al., 2014).

Evidence of prompting by staff observed in this study indicated that staff were actively trying to facilitate communicative responses from students. Prompting and modelling techniques can be very effective but they may also potentially result in students becoming dependent on prompts to communicate (furthering the limitations in initiation skills previously described) and the types of prompts used are critical (Frost & Bondy, 2002; Sundberg & Partington, 2013; Tager-Flusberg et al., 2017). Essential from a verbal behavioural perspective, is to attend to the types of prompts delivered by staff and to assess whether prompts (and what type of prompting) are appropriate for students. Ensuring prompts are faded may best afford students the capacity to independently emit communicative behaviours when required. One final point to note is that by ensuring prompts are faded to and that students develop communication skills they are able use independently, would also ensure that the authorship of the communication belonged to the students as opposed to students simply emitting imitations of communicative messages that were constructed by communication partners.

Consequences as functionally appropriate matches following student initiations.

The final variable documented in this study was to address the extent to which staff responses following student initiations could be described as functionally appropriate matches. Overall, half the consequences provided by staff following 94 total student initiations were assessed as functionally appropriate *matches* or *may match*. *No match* to the communication function was the assessment made for the remaining half, of which 23 (50%)

were episodes where *no response* from the staff participant was observed. Following their initiations, students in this study met a range of responses from staff. Of the total initiation episodes with Bella, less than half (46%) of the responses by staff were assessed as appropriate functional matches. Just over half of episodes with Bella were assessed as functionally inappropriate matches and these were often (50%) instances of *no response* from staff observed. Staff responses following student initiations by Deedee were assessed as functionally appropriate matches during the majority (70%) of cases, but two episodes were assessed as functionally inappropriate consequences because they were occasions where *no response* from staff was observed. Consequences following three mand and tact initiations observed with Sophie were all coded as functionally appropriate matches. Only one prior study by Drain and Engelhardt (2013) noted the consequences that were provided by staff following student initiated communication. Although direct comparison with prior studies and results from this research are limited due to the varied nature of the codes used, results from Drain and Engelhardt (2013) study do offer some points of discussion. If the functional codes of *request* and *reject* that were reported in the study by Drain and Engelhardt (2013) are combined (just under 95%), these acts may have been similar in function to the mand initiations documented in this study. Findings that staff were observed responding to student initiations with consequences of *delivered* or *denied* from the same study (Drain & Engelhardt, 2013), when also combined, equated to almost 60% of the responses that may have been assessed as functionally appropriate matches. Consequences following student initiations that included *acknowledging* alone or *no response* from staff (combined total of 55%) observed in the study by Drain and Engelhardt (2013) may have been functionally inappropriate matches, and functionally inappropriate matches may have been observed in similar proportions to those in the present study.

Given how convoluted naturally occurring communicative episodes are, assessing the appropriateness of responses that occur is no less complex. The previous example where Sophie initiated to gain access to lunch is also an interesting example of when consequences may be assessed as an inappropriate match to the mand function, but may compete with responses that students can reasonably be expected to incur within naturalistic settings so might also be described as appropriate. For example, the response of *no* or *wait* that Sophie incurred is fair and reasonable when assessing the appropriateness of the response to the request itself (we all must wait sometimes despite sometimes wanting things immediately) but is not a response that is likely to support reoccurring initiations. From a verbal behavioural perspective, it is important that communication partners respond in functionally appropriate ways (matches) to communicative attempts of students, particularly those that are emitted in acceptable communication modes. Behaviour followed by provision of consequences that match the function may potentially serve to shape (develop) and increase (reinforce) further communicative behaviours with students. If the target behaviours (learning and educational goals) are to develop and practice functional communication skills then, if taking a verbal behavioural approach, provision of functionally appropriate responses may take precedence over other learning or academic goals and may be a way to improve class learning. Within a verbal behavioural perspective, learning to mand for a pen when a pen is required should be prioritised and academic goals of learning to spell and write the word pen are skills students should be subsequently learned (Bondy & Frost, 2001; Frost & Bondy, 2002; Sundberg, 2014b; Sundberg & Partington, 2013). Another example from the observations conducted as part of this study further demonstrated some of the complexities and importance of staff providing functionally appropriate responses. Deedee was observed initiating towards a staff participant by saying *hungry* when the school bell rang. The response provided by staff was assessed as appropriate in that it *may match* functionally, but

this example may have represented a missed opportunity to potentially reinforce initiation behaviours with Deedee. Dependent on whether the purpose of this initiation was to comment that the bell Deedee heard signalled it was time to eat or that she felt hungry (tact based), or to request food or ask if that bell was the bell for morning tea (mand), again the partial responses render the purpose of some episodes unclear. Either way, although the response of correction (Deedee was corrected that the bell signalled another class, but not morning tea) was factually appropriate, in relation to facilitating Deedee's communication skills adding something to the correction response (such as, *yes, sometimes that bell does signal morning tea, well done Deedee*) may have been beneficial towards her communication skill goals.

Staff providing responses that are functionally appropriate matches may therefore serve as reinforcement for initiation behaviours, particularly following initiations that students emitted in response to naturally occurring non-verbal stimuli (in the example with Deedee the school bell or to gain access to food in both examples) so were spontaneous communication initiations from a verbal behavioural perspective. In contrast, consequences that were assessed as functionally inappropriate matches may serve to decrease (punish) verbal operants attempted by students, particularly consequences of no responses from staff participants. Consequences of no response from staff were observed following one quarter of student initiations in this study, and were observed most often as consequences of Bella's initiations (21 no responses), followed by two no responses observed following initiations by Deedee. Sophie was not observed incurring no response from staff. A possible explanation for all staff *no responses* may simply be that the staff participant did not see or hear the students' initiation. A possible explanation for the high proportion of *no response* provided by staff as consequences following initiations observed with Bella, may be that the communication goals are to reduce instances of communicative episodes, as per reference in Bella's IEP to Bella using loud vocals and assuming an authoritarian role in conversations.

The consequence of *no response* might be appropriate if the goal is to reduce some unwanted communicative behaviours. For students with communicative initiation goals in their IEP's (Deedee and Sophie), episodes of *no response* to their initiated operant attempts may represent missed opportunities to learn and practice initiation skills. Important learning and educational implications to learn from when applying research findings to practice, may be to attend to the teaching and learning strategies employed and the important role of communication partners in delivering responses that facilitate students attaining a robust communication skills repertoire. Indeed further research to determine the effect of staff responses including *no responses* and provision of consistent responses (Drain & Engelhardt, 2013) on the communication skills of students is urgently needed, and perhaps employing a verbal behavioural approach may aid in devising functionally appropriate and consistent staff responses that aid in positive behaviour changes for students.

Strengths and Limitations

The current investigation was unique because it was the only observational study known to the author that utilised Skinner's (1957) account of verbal behaviour and the operant units he described, to document the functional use of high school students' communication skills. Other strengths of this study are that it provided unique descriptions of the communicative episodes observed with female participants and special education staff within a New Zealand high school, including activities within community based settings. Given the heterogeneity of individuals experiencing communication difficulties, and the same degree of variability in functional use of communication skills found with participants in this study, the case study design used is a strength because it allowed for individual student analyses. Most observational studies of communication skills within natural settings have been conducted within educational settings; future research that includes community, home, and vocational settings is encouraged.

There are also some limitations to this study and suggestions for future research. No formal functional analyses of the observed communication skills was conducted, no formal assessment of students' communication skills was made, and no details of student and staff experience and training (including with AAC systems) was collected as part of this study. Observational data collection methods such as in-person and event recording procedures used in this study may have affected the reliability of the dependent variables. To account for these limitations all possible functional codes were applied to each communicative episode, and both observers were familiar with Skinner's (1957) verbal behaviour principles and conducted training prior to observations, and achieved overall high percentages of inter-observer agreement. Future research that includes formal functional analyses of the communicative behaviours observed, captures video recordings to reduce observer effect and increase accuracy of communicative episode coding, and further defines communication skill variables in line with a verbal behaviour account, is encouraged. Consistent across most previous works, including the current study, is the unknown effect of specific components of the various AAC systems (tools, devices, and teaching and learning strategies incorporated) and future research that aims to distinguish and identify the efficacy of each component is encouraged. It is possible that the operational definitions of opportunities to initiate failed to capture all instances of environmental sabotages. Capturing deliberate attempts to manipulate the communicative environment was limited in this study because sabotage techniques may have been missed or completed prior to observations (for example, a staff member may have previously placed a needed item in the incorrect location). Further refinement of opportunities for students to initiate and future research that includes experimental examination of the effects of specific environmental adaptations implemented by staff (initiation opportunity strategies) on students' functional use of communication skills is welcomed.

Conclusion

The verbal behaviour approach taken in this research highlighted some evidence of limitations to students' ability to use their communication skills functionally by revealing little evidence of being able to independently and effectively initiate and respond communicatively. Learning effective communication skills (and being able to use these skills functionally) can enrich individuals' overall quality of life by enabling them to realise their fundamental and basic human rights. Effective communication skills also aid students to develop and maintain social relationships, and for students to be understood by their friends, family, and community members. The school environment and associated routines provide a plethora of naturally occurring communicative opportunities for students to develop and practice functional communication skills resulting in socially significant outcomes during their remaining high school years that continue into adulthood. Everyday routines provide ample occasions for communication partners to capitalise on naturally occurring communication skill learning opportunities, as is done in some AAC system protocols such as PECS. Aspects of communication environments can be described as facilitative and/or compensatory to the development of functional communication skills. Verbal behavioural descriptions from this study suggest some aspects of the communicative environment facilitated students using communication skills functionally and some appeared compensatory. When possible and practical, and when the education goal is to facilitate communication skills, then providing consequences that match the purpose of students' communicative attempts should be prioritised.

If we can agree that communicating (or *linguaging*) is something we do and communication skills are learned, then we can also agree that communication skills can be treated as behaviours. Assessing and treating individuals using methods and strategies that align with applied verbal behaviour analysis principles may therefore be better suited to

individuals with communication skill impairments. For communication interventions (particularly those that incorporate AAC systems), use of behavioural and evidence-based communication skill assessments and aided systems (such as the VB-MAPP and PECS) may best support students and teachers to create and achieve communication skill IEP goals (Donaldson & Stahmer, 2014; Sundberg, 2014b). It is of social significance for all individuals to develop communication skills that can be used functionally within real-life contexts, and that the authorship of the communicative behaviours belongs to the student. It is of equal importance, and urgency, that communication assessment and treatments are predicated on evidence-based practices to best enable students to achieve their full communication potential, to share their ‘voice’ and let them be understood.

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Appendices

Appendix A - Study Advertisement

Do you know someone aged 13+ years who has difficulty communicating?

Do they use (or have they used) aided or unaided communication?



We are looking for participants with previous experience using an aided or unaided communication system to take part in a study to investigate the functional use of communication skills in the school.



Research Participants Wanted



Study Title: Let me be understood: A behavioural investigation into older participants' use of functional communication skills following previous Augmentative and Alternative Communication (AAC) interventions, and the impact of environments on supporting communication.

If you are interested in participating or you have questions about the study

This study is a student project by Tina Bourke,
University of Waikato, Masters of Applied
Psychology Thesis Student, please contact Tina
Email: tina.bourke@waikato.ac.nz
Phone: 021 297 3125
Or Tina's supervisor Associate Professor
Angelika Anderson, University of Waikato,
angelika.anderson@waikato.ac.nz

This study is approved by the Human Research Ethics Committee (Health) of the University of Waikato, questions about the ethical conduct of this research may be sent to the chairperson (humanethics@waikato.ac.nz).

Appendix B - Organisation Information Sheet

INFORMATION SHEET – Organisations

We invite your school or workplace to participate in a study being conducted by Tina Bourke, under the supervision of Associate Professor Angelika Anderson, from the School of Psychology at the University of Waikato. This research is being conducted to fulfil the requirements of a Master of Applied Psychology in Behaviour Analysis with the University of Waikato.

Please read the information below in full, and ask questions, before deciding whether or not to give permission for this study to be conducted within your organisation.

What is the aim of this study?

We want to investigate the use of functional communication skills by adolescents and adults who have difficulty communicating and have previously been taught to use an aided communication system during their usual school or workplace routines. We are also interested in the role of the environment in supporting participants to independently use and practice communication. The study is in two parts with two groups of participants. During Part 1, researchers will observe and record the communication events that occur, including instances of inappropriate communication attempts (for example, crying or stereotypical behaviours), and note the environments in which they occurred. Part 2 of the study will examine the effect of simple environmental adaptations in improving independent communication and functional communication skills.

What is aided communication?

Aided communication are Augmentative and Alternative Communication (AAC) systems that help individuals with communication difficulties to communicate. They can be low technology (picture boards and books) or high technology (speech generating devices, smartphones, and other digital devices).

Who can participate?

We are looking for two groups of participants

- Group 1: One – four individuals aged 13 or over, who have previously been taught to use an AAC system/device (including the Picture Exchange Communication System (PECS)), and currently have limited functional communication repertoires.
- Group 2: The teachers, work supervisors, support personnel, caregivers and/or legal guardians of the Group 1 participants.

What will participation involve?

This study will be in two parts:

Part 1

- Observations (in 20-minute sessions) of both Group 1 and 2 participants for approximately one hour per day, three times per week, during their usual school or workplace routines, over approximately two to four weeks. During these sessions, researchers will record the communication events that occur and the environments in which they occur.
- Group 2 participants will be asked to complete two 10-minute pre-study assessment questionnaires at the start of Part 1.

Part 2

Part 2 depends on findings in Part 1:

- If there are only few communication acts in Part 1, then the lead researcher will implement an intervention to create communication opportunities for Group 1 participants within different environmental conditions to test the impact of the environment on their independent use of functional communication skills.
- Group 2 will be asked to implement simple environmental changes in their daily routines to provide opportunities for communication (e.g. not always provide all required resources). Changes selected will be based on individual routines, needs and preferences.
- Groups 1 & 2 will be observed again as in Part 1, over approximately two to four weeks.
- Group 2 participants will also be asked to complete a 10-minute treatment acceptability rating form at the start and finish of Part 2.

At the end, all participants will be invited to attend a 30-minute presentation of the study findings and will be offered the option of receiving a written summary of the results. Overall, participation is expected to take approximately 10-12 weeks in total.

What will the outcome of this study be?

We expect all participants to benefit from this research. Group 1 participants will likely experience improvements in independent use of functional communication skills. Gains in functional communication skills may also result in associated behaviour changes, such as reductions in inappropriate or stereotypical behaviours. Group 2 participants will likely benefit by any professional learning and knowledge (recommendations and examples) gained about how the environments themselves can facilitate independent use and practice of functional communication skills to inform future work. The organisations and communities of participants will likely benefit by any knowledge gained in relation to environments that best support the successful use of functional communication skills. All participants will be invited to attend a presentation of the results of the study.

The findings of this study will be presented as the lead researcher's Master's thesis to the University of Waikato. The lead researcher may also present the results of this study at a conference or submit an article to a peer-reviewed journal. Please ask the lead researcher if you would like to receive a summary of the study after the thesis has been submitted.

What can my organisation expect and what are our rights?

Participation in this study will remain confidential and no information that identifies participants, organisations, or locations will be disclosed. Participation in this study will not be anonymous because the observers will know who the participants are. To ensure confidentiality each participant and organisation will be assigned pseudonyms (fake names). All data will be recorded and stored using only pseudonyms on a password-protected University of Waikato drive that only the researchers have access to. After submission of the lead researcher's thesis, the research supervisor will store data for a further five years then will permanently delete all data collected.

Giving permission for researchers to recruit, and conduct the research, within your organisation is voluntary (your choice). You are under no obligation to agree to this study being conducted within your organisation and you have the right to decline permission for specific research activities or answer any questions. After permission is provided, you have the right to withdraw permission at any time, without penalty or explanation, by notifying the research team using the contact details below. Up until 2 weeks after the final observation

session, your withdrawal of permission includes destruction of the data collected about participants from your organisation.

How will participants be recruited from our organisation?

After permission from your organisation is given, the lead researcher will provide electronic and/or hardcopies of the Study Advert and Information Sheets and ask your organisation to share these with potential participants within your organisation. The Study Advert and participant Information Sheets instruct potential participants to contact the lead researcher if they are interested in participating or have questions about the study. The lead researcher will gain consent from participants (and their legal guardians) directly, and will be available during recruitment to answer any questions by phone, email, or to meet in person.

What should I do if I am interested in giving permission for our organisation to participate or I have questions about the study?

If you have any questions about the study, or you are interested in giving permission for researchers to recruit participants and conduct this study within your organisation, please contact the lead researcher Tina Bourke via the phone number or email address below.

*Associate Professor Angelika Anderson
School of Psychology, Waikato University
Phone: 07 838 4466 ext 9209
Email: angelika.anderson@waikato.ac.nz*

*Tina Bourke
Lead Researcher
Phone: 021 2973125
Email: tina.bourke@waikato.ac.nz*

This study is approved by the Human Research Ethics Committee (Health) of the University of Waikato. Any questions about the ethical conduct of this research may be sent to the chair of the committee (humanethics@waikato.ac.nz).

Appendix C - Information Sheet Staff/Group 2 Participants

INFORMATION SHEET – Group 2 Participants

We invite you to participate in a study being conducted by Tina Bourke, under the supervision of Associate Professor Angelika Anderson, from the School of Psychology at the University of Waikato. This research is being conducted to fulfil the requirements of a Master of Applied Psychology in Behaviour Analysis with the University of Waikato.

Please read the information below in full, and ask questions, before deciding whether or not to participate.

What is the aim of this study?

We want to investigate the use of functional communication skills by adolescents and adults who have difficulty communicating and have previously been taught to use an aided communication system during their usual school or workplace routines. We are also interested in the role of the environment in supporting participants to independently use and practice communication. The study is in two parts with two groups of participants. During Part 1, researchers will observe and record the communication events that occur, including instances of inappropriate communication attempts (for example, crying or stereotypical behaviours), and note the environments in which they occurred. Part 2 of the study will examine the effect of simple environmental adaptations in improving independent communication and functional communication skills.

What is aided communication?

Aided communication are Augmentative and Alternative Communication (AAC) systems that help individuals with communication difficulties to communicate. They can be low technology (picture boards and books) or high technology (speech generating devices, smartphones, and other digital devices).

Who can participate?

We are looking for two groups of participants

- Group 1: One – four individuals aged 13 or over, who have previously been taught to use an AAC system/device (including the Picture Exchange Communication System (PECS)), and currently have limited functional communication repertoires.
- Group 2: The teachers, work supervisors, support personnel, caregivers and/or legal guardians of the Group 1 participants.

What will participation involve?

This study will be in two parts:

Part 1

- Observations (in 20-minute sessions) of both Group 1 and 2 participants for approximately one hour per day, three times per week, during their usual school or workplace routines, over approximately two to four weeks. During these sessions, researchers will record the communication events that occur and the environments in which they occur.
- Group 2 participants will be asked to complete two 10-minute pre-study assessment questionnaires at the start of Part 1.

Part 2

Part 2 depends on findings in Part 1:

- If there are only few communication acts in Part 1, then the lead researcher will implement an intervention to create communication opportunities for Group 1 participants within different environmental conditions to test the impact of the environment on their independent use of functional communication skills.
- Group 2 will be asked to implement simple environmental changes in their daily routines to provide opportunities for communication (e.g. not always provide all required resources). Changes selected will be based on individual routines, needs and preferences.
- Groups 1 & 2 will be observed again as in Part 1, over approximately two to four weeks.
- Group 2 participants will also be asked to complete a 10-minute treatment acceptability rating form at the start and finish of Part 2.

At the end, all participants will be invited to attend a 30-minute presentation of the study findings and will be offered the option of receiving a written summary of the results. Overall, participation is expected to take approximately 10-12 weeks in total.

What will the outcome of this study be?

We expect all participants to benefit from this research. Group 1 participants will likely experience improvements in independent use of functional communication skills. Gains in functional communication skills may also result in associated behaviour changes, such as reductions in inappropriate or stereotypical behaviours. Group 2 participants will likely benefit by any professional learning and knowledge (recommendations and examples) gained about how the environments themselves can facilitate independent use and practice of functional communication skills to inform future work. The organisations and communities of participants will likely benefit by any knowledge gained in relation to environments that best support the successful use of functional communication skills. All participants will be invited to attend a presentation of the results of the study.

The findings of this study will be presented as the lead researcher's Master's thesis to the University of Waikato. The lead researcher may also present the results of this study at a conference or submit an article to a peer-reviewed journal. If requested on the Consent Form, a summary of the study results can be prepared and emailed to you after the thesis has been submitted.

What can I expect as a participant and what are my rights?

Participation in this study will remain confidential and no information that identifies participants, organisations, or locations will be disclosed. Participation in this study will not be anonymous because the observers will know who the participants are. To ensure your confidentiality each participant and organisation will be assigned pseudonyms (fake names). All data will be recorded and stored using only pseudonyms on a password-protected University of Waikato drive that only the researchers have access to. After submission of the lead researcher's thesis, the research supervisor will store data for a further five years then will permanently delete all data collected.

Consenting to participate in this study is voluntary (your choice). You are under no obligation to agree to participate and you have the right to decline to participate in any specific research activities or answer any question. By signing and returning the Consent Form you are giving your consent to participate in this study. After consent is provided, you have the right to withdraw at any time, without penalty or explanation, by notifying the research team using the contact details below. If you chose to withdraw, up until 2 weeks

after the final observation session, your withdrawal includes destruction of the data collected about you.

What should I do if I am interested in participating or I have questions about the study?

If you have any questions about the study, or you are interested in volunteering to participate as a Group 2 participant, please contact the lead researcher Tina Bourke via the phone number or email address below.

*Associate Professor Angelika Anderson
School of Psychology, Waikato University
Phone: 07 838 4466 ext 9209
Email: angelika.anderson@waikato.ac.nz*

*Tina Bourke
Lead Researcher
Phone: 021 2973125
Email: tina.bourke@waikato.ac.nz*

This study is approved by the Human Research Ethics Committee (Health) of the University of Waikato. Any questions about the ethical conduct of this research may be sent to the chair of the committee (humanethics@waikato.ac.nz).

Appendix D - Consent Form Staff/Group 2 Participants

A completed copy of this form should be retained by both the researcher and the participant.

Research Project: An investigation into older participant's use of functional communication skills following previous Augmentative and Alternative Communication (AAC) interventions, and the impact of environments on supporting communication initiations and practice.

Please complete the following checklist. Tick (✓) the appropriate box for each point.	YES	NO
1. I have read the Information Sheet (or it has been read to me) and I understand it.		
2. I have been given sufficient time to consider whether or not to participate in this study.		
3. I am satisfied with the answers I have been given regarding the study and I have a copy of this consent form and information sheet.		
4. I understand that taking part in this study is voluntary (my choice) and that I may withdraw from the study at any time without penalty or explanation.		
5. I have the right to decline to participate in any part of the research activities.		
6. I know who to contact if I have any questions about the study in general.		
7. I understand that the information supplied by me could be used in future academic publications.		
8. I consent to completing two questionnaires at the start of the study.		
9. If Part 2 is required, I consent to completing a pre-study and post-study questionnaire, and participating in a meeting with Tina Bourke during the study.		
10. I consent to allowing researchers to observe me partaking in my usual school or workplace routines with my associated Group 1 participant at the agreed times.		
11. I understand that my participation in this study is confidential and that no material, which could identify me personally, will be disclosed. I understand that Tina Bourke will be supervised by Associate Professor Angelika Anderson and that they will discuss this research confidentially.		
12. I wish to receive a copy of the findings		

Declaration by participant:

I agree to participate in this research project and I understand that I may withdraw at any time.

If I have any concerns about this project, I may contact the convenor of the University Human Research

Committee (Health) (humanethics@waikato.ac.nz)

Participant's name (Please print):

Signature:

Date:

Declaration by member of research team:

I have given a verbal explanation of the research project to the participant, and have answered the participant's questions about it. I believe that the participant understands the study and has given informed consent to participate.

Researcher's name (Please print):

Signature:

Date:

Appendix E – Student Participant Information Sheet

INFORMATION SHEET – Student/Group 1 Participants

You are invited to provide consent to take part in a study being conducted by Tina Bourke, under the supervision of Associate Professor Angelika Anderson, from the School of Psychology at the University of Waikato. This research is being conducted to fulfil the requirements of a Master of Applied Psychology in Behaviour Analysis with the University of Waikato.

Please read the information below in full, and ask questions, before deciding whether or not provide consent on behalf of a Group 1 participant to take part in this study.

What is the aim of this study?

We want to investigate the use of functional communication skills by adolescents and adults who have difficulty communicating and have previously been taught to use an aided communication system during their usual school or workplace routines. We are also interested in the role of the environment in supporting participants to independently use and practice communication. The study is in two parts with two groups of participants. During Part 1, researchers will observe and record the communication events that occur, including instances of inappropriate communication attempts (for example, crying or stereotypical behaviours), and note the environments in which they occurred. Part 2 of the study will examine the effect of simple environmental adaptations in improving independent communication and functional communication skills.

What is aided communication?

Aided communication are Augmentative and Alternative Communication (AAC) systems that help individuals with communication difficulties to communicate. They can be low technology (picture boards and books) or high technology (speech generating devices, smartphones, and other digital devices).

Who can participate?

We are looking for two groups of participants

- Group 1: One – four individuals aged 13 or over, who have previously been taught to use an AAC system/device (including the Picture Exchange Communication System (PECS)), and currently have limited functional communication repertoires.
- Group 2: The teachers, work supervisors, support personnel, caregivers and/or legal guardians of the Group 1 participants.

What will participation involve?

This study will be in two parts:

Part 1

- Observations (in 20-minute sessions) of both Group 1 and 2 participants for approximately one hour per day, three times per week, during their usual school or workplace routines, over approximately two to four weeks. During these sessions, researchers will record the communication events that occur and the environments in which they occur.
- Group 2 participants will be asked to complete two 10-minute pre-study assessment questionnaires at the start of Part 1.

Part 2

Part 2 depends on findings in Part 1:

- If there are only few communication acts in Part 1, then the lead researcher will implement an intervention to create communication opportunities for Group 1 participants within different environmental conditions to test the impact of the environment on their independent use of functional communication skills.
- Group 2 will be asked to implement simple environmental changes in their daily routines to provide opportunities for communication (e.g. not always provide all required resources). Changes selected will be based on individual routines, needs and preferences.
- Groups 1 & 2 will be observed again as in Part 1, over approximately two to four weeks.
- Group 2 participants will also be asked to complete a 10-minute treatment acceptability rating form at the start and finish of Part 2.

At the end, all participants will be invited to attend a 30-minute presentation of the study findings and will be offered the option of receiving a written summary of the results. Overall, participation is expected to take approximately 10-12 weeks in total.

What will the outcome of this study be?

We expect all participants to benefit from this research. Group 1 participants will likely experience improvements in independent use of functional communication skills. Gains in functional communication skills may also result in associated behaviour changes, such as reductions in inappropriate or stereotypical behaviours. Group 2 participants will likely benefit by any professional learning and knowledge (recommendations and examples) gained about how the environments themselves can facilitate independent use and practice of functional communication skills to inform future work. The organisations and communities of participants will likely benefit by any knowledge gained in relation to environments that best support the successful use of functional communication skills. All participants will be invited to attend a presentation of the results of the study.

The findings of this study will be presented as the lead researcher's Master's thesis to the University of Waikato. The lead researcher may also present the results of this study at a conference or submit an article to a peer-reviewed journal. If requested on the Consent Form, a summary of the study results can be prepared and emailed to you after the thesis has been submitted.

What can I expect as a participant and what are my rights?

Participation in this study will remain confidential and no information that identifies participants, organisations, or locations will be disclosed. Participation in this study will not be anonymous because the observers will know who the participants are. To ensure confidentiality each participant and organisation will be assigned pseudonyms (fake names). All data will be recorded and stored using only pseudonyms on a password-protected University of Waikato drive that only the researchers have access to. After submission of the lead researcher's thesis, the research supervisor will store data for a further five years then will permanently delete all data collected.

Consenting on behalf of a Group 1 participant taking part in this study is voluntary (your choice). You are under no obligation to agree to give consent on behalf of the Group 1 participant and you have the right to decline consent for any research activity or to answer any question. By signing and returning the Consent Form you are giving your consent for a Group 1 participant to take part in this study. After consent is provided, you have the right to withdraw consent at any time, without penalty or explanation, by notifying the research team or your organisation. If you chose to withdraw consent on behalf of a Group 1 participant, up

until 2 weeks after the final observation session, withdrawing includes destruction of the data collected about them.

What do I do if I am interested or I have questions about the study?

If you have any questions about the study, or you are interested in providing consent for a Group 1 participant to take part, please contact the lead researcher Tina Bourke via the phone number or email address below.

*Associate Professor Angelika Anderson
School of Psychology, Waikato University
Phone: 07 838 4466 ext 9209
Email: angelika.anderson@waikato.ac.nz*

*Tina Bourke
Lead Researcher
Phone: 021 2973125
Email: tina.bourke@waikato.ac.nz*

This study is approved by the Human Research Ethics Committee (Health) of the University of Waikato. Any questions about the ethical conduct of this research may be sent to the chair of the committee (humanethics@waikato.ac.nz).

Appendix F - Consent Form Student/Group 1 Participants

Appendix F

CONSENT FORM – Group 1 Participants

A completed copy of this consent form should be retained by both researcher and participant.

Research Project: An investigation into older participant's use of functional communication skills following previous Augmentative and Alternative Communication (AAC) interventions, and the impact of environments on supporting communication initiations and practice.

Please complete the following checklist. Tick (✓) the appropriate box for each point.	YES	NO
13. I have read the Information Sheet (or it has been read to me) and I understand it.		
14. I have been given sufficient time to consider whether or not to give consent on behalf of _____ to participate.		
15. I am satisfied with the answers I have been given regarding the study and I have a copy of the Consent Form and Information Sheet.		
16. I understand that being part of the research is voluntary (my choice) and that I may withdraw consent at any time without penalty.		
17. I understand that I have the right to decline consent for _____ to participate in any of the research activities.		
18. I know who to contact if I have any questions about the study in general.		
19. I understand that the information supplied by me could be used in future academic publications.		
20. I consent on behalf of _____ to participate in this study.		
21. If required, I give consent for Tina Bourke to video record the testing conducted with _____ during Part 2 of this study. I understand that this video footage will ONLY be shared with Tina Bourke's supervisor and to debrief with associated Group 2 participants.		
22. I understand that participation in this study is confidential and that no material, which could identify participants or their organisations, will be disclosed. I understand that Tina Bourke will be supervised by Associate Professor Angelika Anderson and that they will discuss this research confidentially.		
23. I wish to receive a copy of the findings.		

Declaration by participant:

I consent of behalf of a Group 1 participant to participate in this research project and I understand that I may withdraw consent at any time. If I have any concerns about this project, I may

contact the convenor of the University Human Research Committee (Health)

(humanethics@waikato.ac.nz)

Participant's name (Please print):

Legal Guardian's name (Please print):

Signature:

Date:

Declaration by member of research team:

I have given a verbal explanation of the research project to the participant's legal guardian, and have answered their questions about this study. I believe that the participant's legal guardian understands the study and has given informed consent on behalf of the Group 1 participant to take part in this study.

Researcher's name (Please print):

Signature:

Date:

Appendix G - Confidentiality Agreement Inter-Observer**CONFIDENTIALITY AGREEMENT**

I _____ (Full Name - printed)

agree to keep confidential all information and data concerning the following research project:

An investigation into older participant's use of functional communication skills following previous Augmentative and Alternative Communication (AAC) interventions, and the impact of environments on supporting communication initiations and practice.

I agree to conduct observations of the communication events between participants for the purposes of inter-observer reliability using the data collection sheets provided to me.

I agree to keep data collected as part of this study strictly confidential.

I will not retain, or make any copies of the information collected, other than those required for the project.

I agree to conduct myself in accordance with the professional and ethical regulations of the study.

Signature: _____

Date: _____

CODES Partner: Group 2 (G2), Peer (P), other peer (OP), other adult (OA); Mode: vocalisation (V), gesture (G), sign language (SL), high-tech AAC (HT), low-tech AAC (LT), unwanted behaviour (UW), no response (NR); Function: mand (M), tact (T), intraverbal (IV), echoic (E); Access to AAC: in reach (IR), in location (IL), no access to AAC (No AAC); Prompts: no prompt (NP), prompt (P); Type of Prompt: vocal (V), physical (P), vocal model (VM), AAC model (AACM), AAC non-model (AACNM), gestural (G); + specify number: number of additional prompts; Consequence: no response (NR), attention or praise (AP), correction or reprimand (CR), tangible access (TA), help or assistance (HA), escape task or activity (EA), compliance (CM)