The neurology behind supported typing in persons with autism.
A response to ISAAC's proposition on FCT

Kathleen A Berger PT, MS-Psy. PhD
5/2/2014

Clinicians rely on a triad of information avenues to provide best practice for their clients. The American Academy of Speech and Language states that the 3 parameters to be considered for evidence based therapy are: 1) External Scientific Evidence 2) Clinical Expertise/Expert Opinion, and 3) Client/Patient/Caregiver Perspectives [1]. While ISAAC's position on supported typing includes studies that are designed to assess, and clearly evidence, whether there is facilitator influence, it does not address the growing body of qualitative studies, autobiographical and video graphical accounts of persons who have eventually been able to communicate independently, or with little support from a supporting person [8, 9, 10, 11, 41, 53, 54]. Most of these persons were *only* able to attain this level of independence except for a prolonged period of practice, with more extensive support with the assumption that the person is able to pick up on the written word, and communicate in this manner. As most of the above studies include persons with autism, this paper addresses key recent research as pertains to persons with autism. While the qualitative studies, autobiographical and video graphical accounts should provide pause, in the last decade investigators have produced numerous experimental and imaging studies that parallel the observations of clinicians and communicators who have found success with supported typing.

Rehabilitation scientists suggest that therapeutic interventions should focus on the 'key ingredients' of a therapeutic intervention rather than a particular package. There are numerous 'packages' available, at a high cost, for persons with autism. But few researchers have focused on the key ingredients as to why any particular intervention is beneficial or is not. For many in the field of supported typing, including me, it was not the specific intervention, but rather observations that occurred over time [7].

In order to determine whether there is emerging or strong evidence for supported typing techniques – whether it be the rapid prompting method (RPM) [40] facilitated communication training (FCT) [8] or a lesser-known approach, informative pointing (IP) [28], we also must consider what the brain basis, and key ingredients might be. A closer examination of each of these techniques includes key ingredients of:

1) A reliance on touch or proprioceptive cues, or resistance.
2) A reliance on external and multi modal cues.
3) Rhythm.
4) The ability to pick up on the written word without being taught.

The proprioceptive or touch sense

Though *Soma* Mukhopadhyay, who teaches RPM, states that she does not provide any touch, further examination of video of her working with children shows that she does use touch in a variety of ways (http://strangeson.com/playVideo.php?id=40), one is to touch the person on the arm or leg. FCT uses a variety of resistance and touch supports including resistance at the hand, forearm, elbow, and touch at the shoulder [53, 54].

A reliance on external or mutli modal cues

One of the mysteries of any supported typing technique is why the person does not initiate typing on their own. They rely on some external or multi modal (more than one sense at the same time) cue to produce some output. A 'key ingredient' of each of these techniques is that a prompt, or cue is provided. FCT users put out their hand (visual) and provide verbal encouragement (auditory), as well as amplified proprioception through resistance or 'pull back'. The RPM technique uses a variety of prompts, from putting a pencil in the person's hand (tactile), to tapping on word choices (rhythm, visual and auditory) or touch. Additionally, it should be noted that several individuals have 'found' their spoken voice with visual (typed words), combined with the auditory output of a device [10, 54].

Rhythm

Each of these techniques incorporates rhythm, some component of activating the proprioceptive system, and an external 'cue' of some kind. In RPM, the support person provides feedback of touch, rhythm and proprioceptive through touch. FCT provides a pullback and resistance from the board. Both techniques use verbal encouragement such as "Keep going, next letter." or through the pull back of resistance in FCT, in a rhythmic manner.

The ability to pick up on the written word without being taught

Perhaps the most confounding of the questions that needs to be answered with supported typing, is how can people teach themselves how to read, without formal instruction. Most accounts of supported typing indicate that a person with autism has somehow picked up on the written word, and somehow was holding this inside until someone presented a letter board to them.

If there is merit to the first hand accounts and key ingredients of supported typing, then instead of banning supported typing, we need to look further than a double blind study that assesses facilitator influence. We need to consider the full extent of the current literature. I propose an examination of recent experimental and imaging studies of persons with autism may shed some light on why proponents and users of supported typing observe what they do.

First, scientists currently think of autism as a neurodevelopmental dysconnectivity disorder, which mostly affects long distance neural pathways and the frontal lobe [2, 3,4,5,6,11,12,13,16,17, 19, 26, 27, 29]}, e.g. Further, many recent studies indicate that persons with autism have developmental dyspraxia [20, 21, 23, 37, 45, 46] even to a *greater extent* than persons with developmental coordination disorder [18]. Lastly, motor learning studies have evidenced a different motor learning pattern in persons with autism [21, 23, 45, 46]. Let's turn to the key ingredients, and look to recent research to see if other research, not related to double blind trials, might explain the observations of clinicians and persons with autism who use supported typing.

1) A reliance on touch or proprioceptive cues (amplified proprioception), or resistance for new motor skills

Recent studies have evidenced an overreliance on the proprioceptive system in persons with autism to learn new motor skills [20, 33, 49]. There are two primary motor pathways. The first is the proprioceptive, or internal model, pathway. You can think of this as the pathway you would use when you pantomime hitting a tennis ball. You are 'remembering' that movement from the proprioceptive memory of where your joint and muscle position should be. The second pathway is the visuomotor pathway. We use this pathway to adjust to visual cues in real time as when we hit a tennis ball in a real game. We adjust the racquet to hit the ball.

Imaging evidence indicates that the visuomotor pathway is not efficiently connected in persons with autism. Whereas, short connections, that connect the primary sensory cortex to the primary motor cortex that transmit only proprioception, are overly connected [20,33]. The extant these short connections are overly connected has also been negatively correlated with basic motor skills [39]. Though these short connections are overly connected, it is also the case that persons with autism, especially non-verbal persons with autism, process and integrate the proprioceptive system differently and less efficiently than typically developing persons [33, 49 50].

2) A reliance on external and multi modal cues

Most therapies for persons with autism make use of 'amplified' external cues to teach a new motor skill. Applied behavior analysts use touch or 'hand over hand' to initially teach a new motor skill. Relationship development intervention (RDI) therapists frequently use amplified combined cues such as an exaggerated enthusiastic voice paired with an exaggerated gesture (multi modal – visual and auditory). Visual schedules and PECS take advantage of the visual system and, in the case of PECS, the proprioceptive system when a picture is pulled off a paper with Velcro.

Experimental and imaging studies indicate that persons with autism have difficulty attending to biological motion. For example, a typical toddler can differentiate between a stick figure walking like a person, from randomly moving 'sticks', whereas toddlers with autism do not make this distinction [32]. They *do* however; preferentially attend to multi modal cues such as clapping hands (visual and auditory). Perhaps, more importantly, investigators have found increased connectivity between the thalamus and the cerebral cortex in persons with autism [36]. All of the senses except smell pass through the thalamus, thus all external cues. Investigators propose this increased connectivity may take the place of decreased connectivity in the cerebral cortex.

3) Rhythm

Rhythm has been used as a therapeutic ingredient to treat speech and other motor disorders such as stroke and Parkinson's disease [15, 48]. Further, investigators have found that rhythm activates motor areas of the brain [24, 25].

4) The ability to pick up on the written word without being formally taught

Perhaps the most controversial question posed by critics of supported typing is how can someone learn the written word without being formally taught. One well accepted form of communication, PECS, might give some insight. PECS has shown that persons with autism are able to learn the meaning of pictures. It is also important to note that this type of communication relies on the proprioceptive system through physical prompts and physical redirection. Next, I turn to the neurology of the visual pathways, and what we now know through experimental and imaging research.

The visual system, or at least in part, appears to be intact in persons with autism. There are two primary pathways that the cerebral cortex processes visual information. First there is the dorsal stream that processes visual spatial information in relation to movement. Second, there is the ventral stream that processes object recognition. Whereas the dorsal stream (also called the visuomotor pathway) is not well-connected [33, 51], the ventral stream is intact [22, 30, 31]. While the ventral stream allows for *object* recognition, this pathway also allows for text recognition. Further, semantic cognition, or the *meaning* of words is also represented in this pathway [14, 52]. Interestingly, a recent study [47] demonstrated that persons with autism *could* describe the meaning from *object* cues but not *postural* cues. Another sign that the semantic part of the ventral stream is 'working'.

Whereas non-verbal persons are presented with opportunities to meaningfully communicate with pictures, starting with a proprioceptive/touch cue (in this case guidance), how many nonverbal persons are given the opportunity to use text in meaningful ways? Certainly, persons who use supported typing.

I propose that while evidence suggests that when supporting persons to type, there is the possibility of influence, at the same time, there are numerous autobiographical accounts and qualitative studies that parallel new experimental and imaging studies that clearly demonstrate: 1) persons with autism have developmental dyspraxia, 2) they are heavily reliant on the proprioceptive system for motor learning, 3) they are reliant on external and multi modal cues and, 4) the ventral stream of the visual pathway that encodes pictures *as well as* words is intact. Further, this stream encodes not only the visual aspect of words, but also the meaning of words.

I suggest to ISAAC that their position statement needs to be revisited. Though the possibility of influence needs to be considered when assessing best practice for AAC with persons with autism, *not* providing the opportunity to access supported typing would be akin to *not* allowing individuals access to their voice.

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