The Influence of Fast ForWord and Metacognition on the Language-Delayed Learner

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Abstract

The Language-Delayed Learner has benefited from using Fast ForWord e-learning software, not only for the incremental behaviorist and cognitivist learning that have taken place, but also for the metacognitive boost from attention the learner has received. One of the eight studies cited here mentions the Hawthorne Effect, and this paper builds on that idea. This paper rearranges the test variables and control elements of the eight studies cited, setting up the alternative testing constants of: 1) On-line teaching tool (Fast ForWord) and 2) Being "important enough" to be watched, included and listened to. The concepts of learner motivation, brain plasticity and metacognition are added to the collective results of Fast ForWord testing and the Hawthorne Effect. The conclusions drawn are research-based, with a small taste of personal experience (see Epilogue).

For the language-delayed learner (LDL), using Fast ForWord (FFW) software to improve receptive and expressive language has proven to be conditionally successful, if only because the learner responds to the attention; this attention could motivate the learner and lead to metacognition in some learners. Bransford et al (2000), pg. 47, describes metacognition as "the ability to monitor one's current level of understanding and decide when it is not adequate". Metacognition was introduced originally within the context of "studying young children" (Bransford, pg. 47). Bransford also says that children "develop knowledge of their own learning capabilities – metacognition – very early. This metacognitive capacity gives them the ability to plan and monitor their success and to correct errors when necessary." (pg. 234).

The Hawthorne Effect (Bothamley, 2002), named after the Hawthorne Works electric plant where workplace changes made people feel important and thus improved their work performance, is mentioned in Given, Wasserman, Chari, Beattie and Eden (2007) on page 95. This paper strongly suggests the Hawthorne Effect is a factor in all these studies. As language-delayed learners (LDLs) are given (any) attention to improve their language skills, their innate human drives to improve (or show off) skills are prompted into action. The specific FFW software, published by Scientific Learning Corporation (SLC), is important, but so is the attention that the learner receives. Similar improvements are also seen in groups using like software packages, for example, Laureate Learning Systems (LLS), as mentioned in several of the studies cited here. Some studies, both biased and independent, have published statistics that reflect short-term improvements (long-term improvements aren't measured), leading to the conclusion strongly urged here that it is the act of being watched and the subsequent self-esteem issues that produce the improvements.

The constants held in the studies represented in this paper are two-fold:

- The students know they are being observed.
- There is some computer-based media tool used.

The variables across the studies represented are many:

- Ages of learners
- Test locations (home-based or school-based)
- Observers (Parent, Teacher, Peers)
- Number of students per study
- Randomized independent study vs. Tallal, Merzenich, & colleagues (biased)
- Types of delays (Language-delayed, reading-delayed, auditory processing impairments, etc.)
- Some studies discuss masking and psychoacoustic treatments
- Control group variance:

    - Some studies compared FFW and the Laureate Learning Systems (LLS) software, using LLS as the control group
    - Some studies used a control group with no contact and no intervention, often with no language delays
    - Some studies used no control group
- Length of study observance time
- Studies of FFW researched by:
    - Independent groups
    - Scientific Learning Corp. (SLC) and colleagues
    - The U.S. Department of Education/Institute of Educational Sciences (IES)

Given all these variables, what remain constant are FFW and that the LDL improved his skills during the time of observation. The students involved in these studies are described to have one or more of the following:

- Some form of learning disability, language disorder or reading delay
- Developmental dyslexia
- Specific language impairment
- Difficulty in receptive (language received) and expressive (language expressed) oral language skills.

History and Description of Fast ForWord (FFW)

FFW was originally designed by Paula Tallal, a neuroscientist and clinical psychologist, for LDLs of ages 4 through 14. FFW is distributed by Scientific Learning Corporation (SLC), Oakland, CA, which became well-known after being featured on NBC Nightly News. The CD-based and internet-based training has seven computer games that slow down the speed, thus allowing more time for the LDLs to react. The learner moves in a self-paced program, progressing through the identified sounds, going from easy to hard. "As students listen through headphones and respond using the mouse, the software adapts to individual skill levels and responses, adjusting the learner's content exposure and difficulty of items presented so that the student responds correctly approximately 80% of the time." (IES, 2007, page 2). The theory is that the LDLs eventually catch up to their peers, at a normal speaking pace. Givens et al, on page 84, says that FFW "addresses the possibility that sensory stimuli (sound frequencies) entering the nervous system in rapid succession are coded physiologically as a single unit of sound frequencies that fail to induce an appreciation of differentiation between them. The intervention protocols acoustically elongate the tones and speech sounds that slowed the rate, increased the amplitude, and increased inter-stimulus-intervals. Deficits in discriminating speech sounds and tone sequenced have been shown to correlate with phonological processing impairment."

FFW curriculum is learner-centered, and is also an example of behaviorism learning theory. Ertmer and Newby (1993), page 50, state that "Learning is accomplished when a proper response is demonstrated following the presentation of a specific environmental stimulus." When FFW is used in the school environment, aspects of social learning also take place, as the students are aware of each other before, during, and after training together. Reeves (2000), on page 23 in his discussion of educational technology research, states that "naturalistic observations of learning-disabled children using commercial courseware" are examples of interpretivist goals in the field of educational technology research.

Summary of the Studies Cited

First Study: Given, et al (2007) is an independent study of 65 middle school struggling readers, from three Mid-Atlantic schools, assigned to 5 random groups, with a control group, over 12 weeks. There are several interventions, a change of control group mid-study (pg. 85). This study cites many of the other studies listed below, as well as other studies not included; it is published after the U.S. Dept. of Education, IES study (WWC-IES), so Given, et al (2007) is not included in any of those findings.

Their conclusions: "Our results fail to support claims that FFW has a specific beneficial effect on language skills (Merzenich, et al., 1996; Tallal, et al., 1996) and reading performance. Rather, we found that all children made gains over time and that those made by groups who received FFW were no greater than the gains made by children who participated in the other computer programs, or those who received nothing other than the school's curriculum. " (Givens, et al, 2007, page 94).

Second Study: Loeb, Stoke and Fey (2001) studies 4 speech and language-impaired boys, age range 5;6 to 8;1 (years; months), home-based, over 6 weeks, no control group, with criterion-referenced assessments immediately after the intervention and 3 months later.

Their conclusions: "None of our objectives included evaluation of the specific effects of the program's efficacy. Thus, rather than focus on groups of children, we wanted to collect comprehensive data on a few children with language impairments. Of the total 595 items assessed at pre-test and post-test, significant positive change occurred on 58 or 10% of the items. Future experimental investigations should include measures of pragmatic performance to substantiate the preliminary findings of these case studies." (Loeb, Stoke and Fey, 2001, page 19 of 30).

Third Study: Gillam, Crofford, Gale and Hoffman (2001) studies spontaneous language improvements in 4 Texas children, 2 of which were the control group using a like bundle of programs published by Laureate Learning Systems (LLS), programs which do not involve the low-level auditory processing training of FFW. Two of the 4 children are identical twins. The children received intervention for 4 weeks, and assessments were made via the Oral and Written Language scales (OWLS) and by visual and mathematical examination of trends for language sample measures.

No conclusions are presented. "In our clinical experience, children rarely present a tidy picture of change, especially when treatment effects are assessed by language sample analysis. More often, we observe periods of variability and little change followed by periods of improvement and less variability." (Gilliam, Crofford, Gale & Hoffman (2001), page 8 of 28).

Fourth Study: Marler, Champlin and Gillam (2001) studies 7 boys, with 3 of the 7 becoming the control group; the control group has typical language. Two of the 4 LDLs studied FFW and the other 2 studied Laureate Learning Systems (LLS) a similar bundle of programs which do not involve the low-level auditory processing training (slowed speech) of FFW). This study addresses backward and simultaneous masking measurements of the 7 children, ages 6;10 to 9;3 (years; months). This study is intended to enhance the Gillam, Crofford, Gale and Hoffmanl (2001) study (represented here as Group 3), as stated on page 3, "our primary goal was to investigate changes in the auditory processing abilities of 3 of the 4 children who received the two computer-based language programs (referencing the Gillam 2001 study)".

Their conclusions: Marler, Champlin and Gillam (2001) showed no benefit of FFW over LLS. (Given, et al, 2007, pg. 86).

Fifth Study: Scientific Learning Corporation (2008) has a 4-year longitudinal study, of 828 high school students in multiple schools in the Dallas Independent School District (DISD) which covers the academic years of 2004 – 2007. The interventions were conducted in school, covering students with TAKS scores available before and after the 4-year study. Two approaches were taken: the first longitudinal analysis included "all 74 students who used the FFW products during the 2004-2005 school year and had test scores from 2004 (before) and 2007 (2 years after) FFW participation." (SLC, 2008, page 2 of 9). The second longitudinal analysis looked at "544 students who had 4 years of data." (SLC, 2008, page 2 of 9). SLC is the creator and publisher of FFW; of the 5 resources referenced in this study, 3 are SLC colleagues. They like their own product. This study also describes the seven games in the FFW family.

Their conclusions: "After using FFW products, struggling readers, on average, made significant progress towards closing the achievement gap." (SLC, 2008, page 1).

Sixth Study: Friel-Patti, DesBarres and Thibodeau (2001) is an independent study of five non-random private-school children (3 boys, 2 girls) with some form of language delay, ages 5;10 to 9;2 (years; months), with some pretesting done. The intervention lasted 6 weeks.

No conclusions reached, just recommended more study is merited (page 14 of 22). This group is also a part of Group 7's study.

Seventh Study: Thibodeau, Friel-Patti and Britt (2001), companion study to Group 6 above, studied 2 groups of 5 students each, ages 5;10 to 9;1, for 5-6 weeks, with half of the students composing the control group possessing normal language. This study cites extensive methods and auditory processing data results with masking, tonal sweeping frequency, and other psychoacoustic measures "modeled after Wright et al. (1997)", on page 2 of 14. This comprehensive study also references other masking studies (Buss, Hall, Grose and Dev (1999), Bishop, Carlyon, Deeks, and Bishop (1999), Wright et al, (1997), and Marler, Champlain and Gillam (2001)). These studies may help us better understand the origin of language delays and greater ways to help the language-delayed learners; however, these areas are not covered here.

Their findings "suggested that temporal processing and language skills did not change with intensive auditory training when group results were examined." (Thibodeau, Friel-Patti and Britt, 2001, page 9 of 14).

Eighth Study: Troia and Whitney (2003) studies "25 children group assigned to FFW intervention drawn from a field study involving 89 children enrolled in a Title-I or local academic support initiative. One-third of the total group had a diagnosed learning disability or speech-language impairment, and attended Grades 1-6, with a mean age of 9:7. The no-contact control group of 12 students had both a pre-test and post-test after 4-8 weeks of intervention. (Given, et al, 2008, page 87). "The study used a pre-test / post-test norm-referenced design with a no-contact matched sample control group. Twenty-five students were in the FFW treatment condition and 12 students were in the control condition. Children were selected for the control group based on the same nomination criteria as children who participated in FFW and matched for grade, special education eligibility and IQ." (Troia and Whitney, 2003, page 465).

Their conclusions:

"Research findings from brain imaging studies indicate that temporal processing is seated in the left hemisphere and that, in some individuals with language and reading problems, there are anatomical and physiological differences in certain brain structures in the left hemisphere that are responsible for processing rapidly changing information (e.g., Merzenich & Jenkins, 1995; Merzenich, Schreiner, Jenkins, & Wang, 1993; Nagarajan et al., 1999; Tallal, Miller, & Fitch,

1993). Thus, it is plausible that these deviations in brain morphology are responsible for the acoustical perceptual deficits and other sensory deficits seen in children with disabilities." (Troia and Whitney (2003), page 467. These "deviations" or missing/atypical neural pathways can be created purposefully, due to the miracle of brain plasticity. These learners are not without hope; nor is this purposeful learning easy or quick.

"Until recently, there was limited opportunity for independent replication and extension of these (SLC's) findings in experimental investigations; the developers of FFW were understandably reluctant to release the software to other researchers before related patents and licenses had been granted." (Trois and Whitney, 2003, pages 470-471). "Our findings are in stark contrast to the findings reported by the developers of FFW and the SLC (Merzenich, et al, 1996; Tallal, et. al., 1996) and are more in line with those reported by Hook, et al. (2001)." (Troia and Whitney, 2003, page 486).

Summary of IES Results

U.S. Dept. of Education, IES, What Works Clearinghouse Intervention Report (WWC), July 9, 2007 (published before Givens et al, (2007) but after all the other resources) cited the following:

Of the 115 IES studies represented in this summary, 93 were conducted by Tallal and/or colleagues at SLC.

Of the 115 IES studies presented, five studies met the WWC-IES evidence standards, 1 study met the WWC-IES standards with reservations, leaving the balance of studies that did not meet WWC-IES evidence due to the following exclusions:

- Study did not focus on domains specified for this WWC-IES review.
- Study did not target Kindergarten through 3rd grade.
- Study did disaggregate data for students in other grades from Kindergarten through 3rd. (The WWC-IES studied K-3rd only.)
- Study did not use strong causal design or comparison group.
- Study did not focus on students learning to read in English.

Based on the 6 studies that met WWC-IES evidence standards (with and without reservations), The WWC "found positive effects on alphabetic and mixed effects on comprehension." (IES, 2007, page 5).

"Using the criteria articulated by the IES, Dept. of Education (Whitehurst, 2003), the comparisons of pre-and post-intervention data, which is the preferred format of SLC when presenting results of FFW intervention, lack "possible evidence" for efficacy. That is, IES insists that randomized group assignment and the inclusion of a non-intervention control group

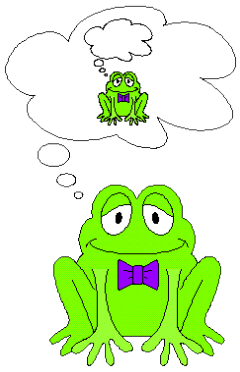
are crucial in determining treatment efficacy. To date, these have not been widely employed for examining intervention programs such as FFW." (Given, et al, 2008, page 88).

The WWC-IES cites all studies chosen for this paper except Loeb, Stoke and Fey (2001). Given, et al (2008) is also not included because it was published after WWC-IES.

The Hawthorne Effect, Motivation and Metacognition

Given, et al (2008) supposes the Hawthorne Effect has influence in these studies on page 95; so building on that thought, how does one measure the Hawthorne Effect, and how does the Hawthorne Effect influence the motivations of our LDLs? How does a LDL say, "I want your attention and your approval"? If she wanted merely my attention, she could use inappropriate behavior, as some do. But, what if she wanted to achieve, to learn, but lacked the neuro-typical tools to state her motivation? Couldn't she, by trying her personal best, by basking in the sunshine of being observed, actually achieve approval by her performance, because she was motivated? What if that achievement was also metacognitive, that learning phenomenon of knowing she was learning and liking it?

The Hawthorne Effect states that as the various test and control elements changed (both for and against expected worker improvements), as long as the employees felt important, the work output improved; in a parallel way, FFW has many redeeming features, the strongest feature (asserted in this paper) being that someone important (teacher, parent, or peer) is watching. The LDL undoubtedly knows that he or she is struggling, not quite up to what peers are doing, and this quite possibly affects their self-esteem--even if those exact words are never audibly expressed. The LDL, if he or she improves because someone important is watching, is therefore aware of and responds to the attention. This implies metacognition: "I know that I am learning." Metacognition also ties into motivation: "I know I am learning, I like this feeling, and I want to learn more."



Learning for the LDL begins with Behaviorism and moves to Cognitivism, Social Learning and Community-based Learning. Ertmer and Newby (1993) on page 55, describe the seeds of Behaviorism as learning "accomplished when a proper response is demonstrated following the presentation of a specific environmental stimulus". This is what happens in FFW, as a learner-centered intervention/curriculum. Then, as the LDL continues to learn by (enforced) Behaviorism, somewhere along the path, Behaviorism builds to Cognitivism. Cognitivism, as asserted by Ertmer and Newby (1993), page 57, occurs as learning becomes "more complex cognitive processes such as thinking, problem solving, language, concept formation and information processing (Snelbecker, 1983)." As the LDL progresses in learning, Ertmer and Newby (1993), on pages 58-59, state that "Learning is concerned not so much with what learners do but with what they know and how they come to acquire it. (Jonassen, 1991b). . . . The learner must believe that the knowledge is useful in a

given situation before he will activate it." Ertmer (2005) on page 31, discusses that "once a tool is valued, the emphasis can switch to its potential for accomplishing additional or new tasks." As these new tools and learning processes grow, accumulate, and mature, the LDL can begin to feel the joys of social learning and community-based learning in the classroom setting. The vast majority of the FFW research addressed in this paper is classroom-based, allowing the LDL to navigate through learner social distractions, group learning, social learning, peer imitation and modeling, and feelings of community. For the LDL, these learning components don't come naturally but are earned by hard work and tenacity. Jonassen (2003) says on page 1 that learning is biochemical activity in the brain, that at the most material level, learning requires a neurotransmitter to be released from the hippocampus which then transmits the electrical pulses between the neurons of the brain. "Patterns of behavior and cognitive activity are associated with patterns of neuronal firing." (Jonassen, 2003, page 5).

Now, add the power of metacognition and motivation to the LDL's progression of learning and what tools and practices they are valuing:

> "Absent wanting to learn, the learning context is unproductive or counterproductive. Learning is a process that occurs in an interpersonal context and is dynamically comprised of factors . . . as motivation, attitude, cognition, affect, and self-regard. Of all the factors comprising and influencing the process of learning, the strength of *wanting to learn* may well be the most fateful." (Sarason, 2004).

The strength and intensity of *wanting to learn* and *wanting to improve* of these observed LDLs flow from their individual motivation, as these LDLs continue to build neural pathways the hard way. Brain plasticity and desire are the performance keys, and for this, FFW merits the market credibility they have received thus far. To repeat a point: Jonassen (2003, page 5) discusses learning as "knowledge as a biochemical activity of the brain", with the release of neurotransmitters that aids the transmission of many tiny electrical pulses between the brain neurons (page 5). If these electrical roads aren't automatically produced (the neuro-typical child learns "automatically"), these roads can still be built the hard way, purposefully, by the LDL. This is the magic of brain plasticity. FFW, as a digital learning tool, delivered either on-line or via DVD media, would be useful to LDLs as they build these neural pathways. Since learners vary in their learning styles, and different media instructional design tools are effective and efficient for various learners, FFW would always help some learners.

Now combine The Hawthorne Effect, metacognition, motivation, and learning progression in the life of the LDL, and FFW becomes a useful tool. FFW employs interpretivist goals of educational technology research (as we saw earlier in Reeves, 2000, page 23), but could become far more useful to the LDL if the FFW family of products were to be evaluated and upgraded using development goals. Reeves (2000), page 27, encourages educators to focus on development goals to bring on lasting improvement, and to do this by humbly looking into the future, and applying original thinking and innovation. We must passionately work on the

tenacious, hard-to-fix, complex learning problems, applying "revolution, often laden with emotion" (quoting Reeves, 2007, on page 27, quoting Kuhn). The number of LDLs is increasing, and we must improve our design principles to better serve them in the future. These learners beg for our best attention and innovation to refine curriculum so that they may benefit and become productive citizens. Reeves (2000), page 26, asks the question "Is it possible to create a practical and effective intervention for an existing problem . . . in the real world?" FFW could continue to be a practical and effective intervention in the quest of improved learning and a better life for LDLs, even more so if on-going improvements are continually made to the FFW family of products.

Epilogue

My LDL is 38 months old. As he sits on my lap and points to/touches the monitor screen, we use Starfall.com, not FFW, because it is age-appropriate and free. I know him so well, so it is crystal clear to me when he is in the flow, aware and excited that he is learning. As we continue daily to intervene 24/7, we help him build neural pathways the hard way by overcoming sensory integration deficits that are playing havoc with his normal development. We are playing catch up. He shows his joy of learning and the excitement that practically vibrates through his eager little body. He asks repeatedly for time with Starfall.com, clearly, pre-verbally communicating, "Now, Mom". He is fully engaged and displays the thrill of learning by his vocalizations and by his kisses (in his near-frenzy state, more like saliva face plants, actually). This young LDL knows he is learning, he celebrates being observed/working together, and he wants more. He couldn't be the only learner who feels and thinks this way.

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