THE SCIENCE OF FLUENCY

By Anna Margolina, PhD

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“Why do you laugh so often?” This was the question that John Harrison asked me during one of our first conversations over Skype.

I wasn’t even aware that I had this habit. But then I started paying attention and soon realized that he was right. It seemed that this small nervous laugh was coming out every time the content of my speech became too emotional. I had no idea how to express my emotions, so I masked them with a laugh.

I contacted John Harrison soon after I discovered and promptly devoured his book “Redefining stuttering”. At this time I was a mess. I had poor control over my speech – my voice would easily become high pitched (something I also wasn’t aware of, until John commented on this) and my speech rate was often too fast. This speeded-up speech was frequently punctuated with painful struggles - blocking episodes that could last up to seven seconds (according to the official evaluation).

From time to time I would enter a speech block from which there was no escape, and then my struggle could last for a really long time. To make it even

worse, it was accompanied by strong facial contractions, eye squeezing, cheek puffing and other involuntary movements. Even one such episode could ruin any pleasant memory, such as having a party with my friends. Instead of remembering all the happy moments, I would ruminate over the time when I couldn't deliver a punch line, thus turning an attempt to tell a joke into an embarrassing experience. I imagined, of course, that everybody at the table remembered my blocks as long as I did.

Ups and downs of the recovery process

For someone who stuttered for almost 40 years I was blissfully ignorant. My knowledge about stuttering could be easily summed with just one phrase, "It is incurable." This phrase had been repeated over and over by many therapists, and it became imbedded in my mind. But as soon as this belief was shattered by many real- life examples of successful recovery from stuttering, there was nothing left that would prevent me from absorbing new ideas.

At first, inspired by the book *Redefining Stuttering*, I started experimenting with my speech on my own, but soon realized that it may take too long. I was too emotionally involved with my stuttering, there were too many issues attached to it. I felt lost in the jungle. I needed a guide and a coach. John Harrison, as someone who was able to overcome his own stuttering, seemed a perfect candidate.

As we progressed with our investigation of my speaking habits, I accumulated more and more evidence of my tendency to hold back and block while I spoke. To allow emotions to emerge, John advised me to slow down my speech and pause often. Soon I noticed that slowing down my speech and coloring it with emotions led to more fluency, since it allowed me to stay in touch with myself. I still had plenty of stuttering episodes in my speech, but it became easier to manage my hard blocking.

In addition to having sessions with John Harrison, I also started sessions with NLP practitioner Bob Bodenhamer, author of the book *Mastering Blocking and Stuttering*. I had a suspicion that my tendency to block my emotions was rooted in my childhood memories. After one of the sessions, something clicked, and I suddenly started speaking with amazing fluency.

However, I soon discovered that the recovery process wasn't as smooth as it seemed initially. It had its ups and downs. For about four weeks I spoke with a freedom and flow that I had never imagined was possible.

Then, one day I had a minor block and after that I had a dream in which I stuttered just as badly as I did before. When I woke up, I felt tension in my throat, and that day I had some minor blocking. It was at this point that I remembered John's advice to slow down

and try to express my emotions as freely as possible in order to regain fluency. Even though my stuttering remained very mild and occurred only in some situations, I yearned for the state of effortless fluency I had tasted and couldn't forget.

The key to fluency

As I kept practicing my art of slow and expressive speech, first with John, then in Toastmasters and finally in my clown and acting class (in which I enrolled with the goal of exploring my silly and expressive side), I kept trying to find the key to the state of free flowing fluency. It seemed that this state had distinct characteristics. Words gently rolled from my tongue. I didn't plan what to say. The moment I knew what word I was saying was the moment I said it. I wasn't listening to my speech or monitoring it. I was going with the flow.

It was easy for me to see how different the stuttering state was, because it occurred so rarely now. When stuttering, I'd suddenly become self-conscious. I'd become aware of the word I was going to say, and I was sure that on this word I would block. Sometimes I did, and sometimes I was able to avoid it by slowing down and trying to speak with more expression.

This was something I had no explanation for. How could it be that I would become fluent, then get some

of my stuttering back, and then again become more fluent? And what was it about slow and expressive speech that made even my stuttering state more fluent?

All this occurred in 2010 around the time the media created a big fuss about the discovery of “stuttering genes.” Many journalists hailed this research as the one that finally solved “the mystery of stuttering” and made all other theories obsolete!

To my dismay, this ignited fierce discussions on whether John Harrison, Bob Bodenhamer and others who help people who stutter to regain more fluency could really do them any good, or whether they just fostered unrealistic dreams, from which a devastating fall to the harsh and sobering reality would inevitably follow.

Looking for answers

To me all this talk about stuttering being genetic and therefore incurable held little interest because of my newfound fluency. It was something that no other method of therapy had ever given me.

But since I had a medical and biological education as well as a PhD in biology, I became curious as to how the existence of genetic anomalies associated with stuttering might fit into John Harrison’s hexagon theory of stuttering. There was certainly a place for it because one of the points on the hexagon was

labeled “physiological responses.” I knew that physiological responses could be influenced by genetics, but I wanted more understanding.

The main obstacle on the way to understanding was my lack of specific knowledge in the area of brain research. However, I could grasp the general ideas, and I could see whether the proposed theory could be applied to everything I observed in my own recovery process. My goal was to find something that I could use not only to explain changes in my speech, but also to design a strategy to deal with occasional blocking episodes as well as to make sure that my old way of blocking doesn’t return.

From the genetic studies it appeared that there were some families in which stuttering occurred more frequently (although this wasn’t the case with me.) Also, an analysis of a large family from Pakistan showed that many stuttering individuals of this family had a mutation in the gene *GNPTAB*. But three stuttering persons from this family did *not* have this mutation and apparently stuttered for a different reason.

Even more intriguing was the fact that 11 subjects from the same family had one or two copies of this mutation, but “currently didn’t stutter” (it was not clear from the article whether or not they stuttered before). This mutation was also found in two unrelated stuttering subjects from Pakistan as well as in one

who didn't stutter. However, none of the studied PWS of North American-British origin had this mutation even though they all had a family history of stuttering (one person who had this mutation turned out to be of Asian-Indian heritage). If we are talking about something as universal as stuttering, we certainly cannot pin our hopes on a mutation that appears only in certain nationalities.

Two other mutations were in genes *GNPTG* and NAGPA; however, none of those mutations were found in any of the Pakistani PWS who were studied. Well, maybe these mutations were very common among North-American PWS? It didn't appear to be true either. Among 270 unrelated North American-British PWS only a few had this mutation. Four persons had mutation in GNPTG gene and six persons (all of the European descent) had mutations in NAGPA gene (total frequency for both mutations – less than 3%). The researchers didn't find mutations in these genes in the control subjects, which led them to claim that the mutations they found were the cause of stuttering.

For me, that conclusion seemed too big a jump.

First of all, researchers selected only those PWS who had a distinct family history of stuttering; therefore, it remained unknown how frequently those mutations occur in the rest of the PWS population. Secondly, what about those individuals who stuttered as children,

but later recovered? What about those who gained fluency as adults?
Probably the most intriguing finding in this study was that all of the above- mentioned mutations affected certain enzymes found in lysosomes – waste disposal stations of the cells. However, it remained unclear how exactly those mutations interfered with fluent speech. What specifically did they change in the brain?

Because of the lack of available genetic mapping of the human brain, researchers used maps for the mouse brain and discovered that genes *GNPTG* and NAGPA were expressed predominantly in the areas responsible for emotional processing and motor coordination. As the authors pointed out “a person’s emotional state can exert a strong effect on the severity of stuttering.” [1] I can’t agree more.

Yet another genetic study featured an individual from Brazil with complex speech/language problems including stuttering who had a mutation in a completely different gene - CNTNAP2 – which was a gene associated with various speech/language pathology and autism.[2] Also, a different mutation, this time in geneDRD2, was found in some Han Chinese PWS.[3]

All in all, those genetic studies suggested that in a very limited number of cases, people who stutter had a genetic condition that in some obscure way might

be affecting their speech production. But it is still unclear what aspects of speech production are affected by genetics, since most people who stutter can speak fluently under some circumstances. Also, since there are many who stuttered but were able to gain a significant degree of fluency, it is unlikely that any of those mutations can cause direct interruption of speech flow.

The mystery of the stuttering brain

Brain imaging allowed scientists to accumulate a load of data about “the stuttering brain”. At the first glance the science seemed very convincing – there were indeed some distinct differences in the grey and in the white matter observed in the brain of those who stuttered. However, these differences were much less noticeable in the brain of children aged 9-12 years compared to the adult PWSs brain. For example, children of 91-2 years of age didn’t have any of the right hemisphere asymmetry that is found in the adults who stutter. [4].

According to the researchers, it was technically impossible to perform this study on younger children – in other words, on those who were at the very onset of stuttering. But those who participated in the study already had several years of stuttering behind them that occurred in their most formative years. It seemed like the brain of 9-12 year old children who stuttered occupied an intermediate position – it looked like it

was still changing.

What was changing it? Were these differences the cause of stuttering or the consequences of it?
It is well known now that the brain, even in adults, is plastic and undergoes structural changes. For example, a famous study of London taxi drivers' brains showed enlargement of the brain area responsible for navigation [4].

Surely if driving a taxi for a few years can change your brain, speaking with stuttering for several decades could do this, too.

Furthermore, there is substantial evidence that various interventions can elicit structural changes in the brain.

Structural changes

For example, it was found that assisted recovery from stuttering with the help of a professional actually caused changes in the structure of the brain compared to the unassisted (spontaneous) recovery in adults. It is worth mentioning that unassisted recovery was associated with deeper healing compared to recovery following medical treatment. For example, those who recovered on their own as adults didn't have the white matter anomaly observed in people who stutter, although they retained some differences in grey matter. Nevertheless, those

differences, whatever their cause, apparently did not prevent those people from speaking fluently [5].

Still, all this science couldn't explain the changes I observed in my own speech. If my stuttering was caused by genes or a brain anomaly, what happened to all those factors when I started speaking fluently? Did they go on vacation? Did they take a really long nap and then wake up to nag me some more?

The science of fluency

In 2011, I came across a fascinating article, which shed light on this issue. The article titled "Simulation of Feedback and Feedforward Control in Stuttering" discussed the possibility that stuttering was caused by a different method of quality control in fluent people than in those who stuttered. [7]

The authors focused on two primary methods of speech control in the human brain – feedback and feedforward. Feedback requires constant auditory monitoring of produced speech. Such monitoring is crucial for language development. An infant first listens to the sounds of speech, all the while building a sound database in the brain. Then the infant starts babbling and producing a wide range of sounds that are matched to stored sounds in the brain.

Every time an error is detected, the position of articulators is corrected and the new sound is

matched to the “correct answer.” Such error-based monitoring allows an infant to adjust movements of the tongue, jaws and lips to the point when they can produce the correct sound.

The same probably happens with grammatical structures. As a child speaks, his or her brain detects mismatch errors in the sentences structure and adjusts signals accordingly.

But fluent speech requires a different method of control, called *feedforward* due to its high rate and complexity. This type of control is the prerequisite for fluency and is not error-based. The brain monitors signals (commands) as they are sent to the articulators with only a minimal control of the result. The commands are so well learned that they can be trusted to produce the result without constant checking for errors.

According to the authors, the sequence in this model is as follows:

1. Tune feedback control system during babbling (self generated speech sounds),
2. Learn an auditory target, when a new sound sample is present,
3. Learn a feedforward command for the sound by practicing its production. The authors hypothesize that in people who stutter, feedforward control is weak, so feedback remains the dominant form of speech

control. They note that stuttering usually starts around the time that children start switching from feedback to feedforward mode.

However, in my opinion the authors missed a good opportunity to discuss what factors other than genetics or brain abnormalities could prevent or delay a normal transition to the feedforward mode of control. Using a computerized model of speech production, the authors showed that extensive errors detected by the feedback mechanism may cause the system to reset and repeat the sound.

They also demonstrated that feedback control can be cancelled by the introduction of white noise. White noise makes auditory feedback impossible and encourages a reliance on feedforward control. This phenomenon has been long known and is used in some fluency enhancing devices. The loud noise prevents those who stutter from hearing their own voice. In most cases masking out the person's speech magically extinguishes stuttering.

The authors believe that their theory also explains why stuttering more often occurs in the beginning of the speech or word. Feedback control is useless if speech has not even started yet and attempts to monitor something that isn't there may result in a perceived "block".

(I imagine this as hesitation that occurs when

someone who is not very physically fit needs to jump a wide crack. If you jumped many cracks before, you can just do it. But if you are unsure where your feet land and you know that you have no way to control this after you make the jump, you may feel pretty much blocked.)

This idea confirmed my own observation that fluent speech *feels different* from stuttered speech. It also seemed to agree with John Harrison's article, "Zen in the Art of Fluency," in which he compared fluent speech with the effortless but precise performance of Zen archers, who could hit the target without consciously aiming.

This also agreed with what I learned in my acting class – namely that a performer must be able to abandon self-consciousness and be fully immersed in the flow of the moment to prevent "choking" on stage. In short, when we start watching for errors, we are more likely to trip.

But I failed to see why the authors believed that such overreliance on feedback could only be a result of some brain anomaly. For example, it is known that feedforward control is crucial in sports, since athletes often must be able to act automatically. Such automatic action requires many hours of practice.

When enough trust in the ability to perform the skill is built, the athlete can let it go and switch to the

automatic mode.

However, if a traumatic accident or a brutal failure occurs before such transition is made, the switch to automatic mode may never happen.

Thus it seems very probable that when parents or teachers draw a child's attention to his or her "stutter" (which naturally occurs in the large percentage of children), they add new sinister meaning to any minor hesitations or repetitions in the speech. This lack of trust in one's own abilities can halt the transition to the feedforward mode of speech control.

Letting go of control

In the Academy Award-winning movie "The King's Speech", there is a scene in which Lionel (the therapist) keeps annoying his patient, King George VI of England, until the king explodes. In his angry outburst the king suddenly speaks fluently. This scene reminded me of my own experience, where the initial onset of strong emotions was accompanied by an increase of blocking, however, after reaching some threshold, (i.e.: if I exploded and "blew off the roof"), my speech would then become perfectly fluent.

Why?

Because at that point I stopped caring about the consequences.

Many PWS report that strong emotions make them uncomfortable and they tend to suppress those emotions rather than express them. Since voice is a vehicle for emotions, the perceived need to control one's emotions may typically lead to overreliance on feedback control in speech.

The issue of trust

Another possible reason for not trusting yourself is fear of negative reaction. For example, if a husband returns home late and his wife asks him "Where have you been?" - a question for which he hasn't a good answer - he will tend to hold back and speak carefully. In the same way, a child who is frequently unsure whether or not his or her words or actions will bring the hammer down on them may also exhibit a heightened degree of control in speech. In fact, there can be many factors that prevent a child from making a timely transition to feed-forward control.

Because of robust adaptive mechanisms of young children, however, a transition to feedforward control may still occur spontaneously. High rates (80%) of recovery from stuttering in childhood indicate a rather wide window of opportunity when natural switching to feedforward mode is still possible. But if the need to remain in feedback mode grows deep and strong roots, the switch to feedforward control becomes difficult to accomplish.

I don’t dismiss the possibility that there could be some physiological reasons why for some people it may be difficult to develop feedforward control or why their feedforward control crushes under stress, but to me it doesn’t seem a requirement.

Especially for individuals who can speak fluently under some circumstances, there appear to be plenty of other explanations.

For example, if you were often criticized and disapproved in your childhood, you may carry “the judge” with you all the time and feel the need to monitor your performance. This can explain why choral reading and speaking to animals often bring fluency. They remove “the judge” from the equation. It is fairly hard to imagine your dog being critical of your speech. And in the chorus, you are just a voice among many others.

Many people do not stutter when they are speaking to themselves. On the other hand, some people do stutter even when they are alone, because even in the privacy of their solitude they cannot stop themselves from being their own judge.

Fear of certain “difficult” sounds also encourages feedback control, because you never let go of control as long as you have red flags all over the alphabet.

What about me?

Since I spoke fluently after NLP sessions, I knew I didn't have anything that physically prevented me from using feedforward control in my speech, except for my reluctance to let it go and except for the lack of practice of doing so in everyday situations. I supposed that what happened after the memorable session with Bob Bodenhamer when I started speaking fluently was my sudden realization that I did not have to monitor my speech anymore and that I could trust my ability to speak.

The profound healing of childhood hurts allowed me to reframe the experiences that had triggered distrust in my ability to simply let go and speak. Similarly it removed the need to constantly monitor my speech for errors. I suddenly realized that my belief that I never would be able to speak normally wasn't based on anything but empty words heard in childhood.

I realized that my fear of stuttering was irrelevant to my current adult life and that some negative experiences that I had with my speech in childhood could have been caused by problems in my speech for reasons other than stuttering.

Did I speak too fast? Did I swallow word endings? Did my thoughts follow a rambled and wild pattern that no one could follow? I do not know, and I am not going to search for answers. But I had a strong feeling that whatever it was, as an adult, I did not have to fear

something that haunted me in my childhood.

This positive reframing removed an invisible barrier that was preventing my feedforward mechanism (the system for automatic control of speech) from taking over.

And when that happened, fluent speech followed.

I have found, however, that progress seldom follows a completely linear path. One day I had an unanticipated block, which opened a gate for an old distrust to creep in.

More distrust followed a dream in which I had a vivid image of myself resuming my heavy blocking. The result was the return of some blocking due to resumed feedback control of my speech. But since I didn't have the same reaction to blocking that I had before the NLP sessions, and since I deliberately slowed down my speech rate, thus reducing the possibility for errors, I had only mild disfluency and none of my previous heavy blocking.

A vision for the future

When I look in the future, I see somewhere far ahead a comprehensive theory of stuttering developed in collaboration between neuro-scientists, behavioral specialists, psychologists and people who stutter. This theory would include the influence of individual

history, consequences of growing up with stuttering, individual emotional makeup, as well as some neurophysiology and genetics. This theory will pretty much resemble John Harrison's hexagon and will present stuttering as a system with many interacting and interdependent components. But as this hasn't happened yet, I would like to make my small contribution and put in the center of John Harrison's hexagon two additional components:

1) An ability to activate and maintain feed forward speech control,
2) A level of an individual's reactivity to imperfections (real or perceived) in his or her speech.

Stuttering in a form of repetition and minor hesitations is more likely to occur when an individual speaks with a high degree of self-consciousness, constantly scanning his or her speech for errors. Such "stuttering" often appears in the speech of fluent speakers in moments of self-doubt and anxiety.

However, people who stutter also have a high intolerance to any disturbances in their speech. And they have learned to counteract this by holding the breath and tensing vocal cords and other muscles involved in articulation. Such behavior results in more prominent and struggled blocks. An extensive "library" of difficult words and situations stored in the memory of most adult PWS makes it even more difficult to let go of control.

The fluent state achieved by a majority of the population without any effort resembles that of an athlete who is able to entrust his or her success to automatic, well- learned movements and paying little attention to minor flaws. If an athlete starts thinking “Oh, I fell down at this spot during the last game, what if I fall again today”, it will be a disaster. Therefore, they don’t do this.

Building this kind of trust, after keeping yourself in check for decades, is not easy. However it can be done. And even though for some people who stutter it may initially be necessary to increase control over their speech in order to learn new speaking patterns (such as speaking more slowly, using more efficient type of breathing etc), it is a natural fluency, a state of full immersion into the flow of conversation and letting go of control, that should be an ultimate goal.

At the moment this article is written, most of my speech is fluent, and by fluent I mean effortless carefree speech with very little control, which feels very enjoyable (in contrast to my past turmoil and anguish). However, I still experience some situations (although they are rare now) when I feel blocked.

In those situations I slow down my tempo and try to re-capture the fluent state. Typically with very rare exceptions, I am able to jump back on the fluent tract and let go of the control.

To me fluency feels like a strong current that sweeps me and carries forward through the conversation with words rolling effortlessly wave-by-wave. It feels very good. I know that I might have had some issues with speech production when I was a small child - problems that could have made my surrounding too harsh on me and convinced me that I shouldn't trust my ability to speak. That fear could have made it impossibly difficult to switch to unconscious control at the usual time.

But at present there is nothing that prevents me from speaking fluently.

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