# Concentrating on Mistakes

John L. Gordon – September 2006

## Abstract:

Whilst enacting the belief that occasional redirection of focus to a new theme is good for creativity, I became interested in the mistakes that I was making. Not that making mistakes was a new thing, it was the analytical interest in them that was new. Designing and creating a very simple EPROM programmer using things that I already had was intended to be stimulating and allow me to think about different things, different that is from knowledge. The programmer was to be for one type of EPROM that I used for my 'Intelligent Home' project (M27C2001 for anyone interested) and intended to address a long standing problem that could have been solved by purchasing a programmer.
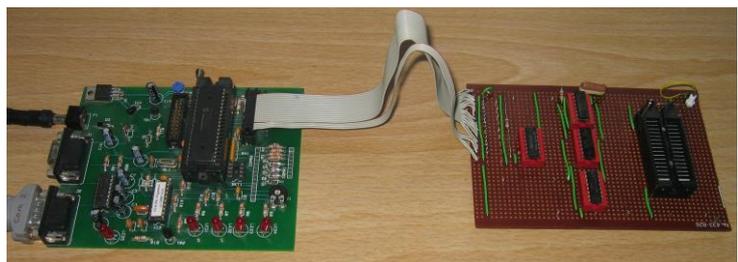
The results were that I ended up with a working EPROM programmer and also some thoughts about mistakes that are the subject of this paper. The examples of the mistakes made during this short project are simply intended to represent general mistakes. They are also there to help place the whole thing in context. Whilst the subject of mistakes will be very much larger than the part of it addressed here, it is still possible to draw general conclusions from the analysis that could give food for thought to business and organisational planners as well as individuals involved in project work.

The main conclusion to be drawn is that efficient working needs to take account of the way people are. Whilst science still does not know how the sum of neuronal, endocrine and physical systems affect the whole person and the way they function, some important advances have been made. It may be true to say that people do not always work the way those managing people would like them to work.

## Introduction:

In a recent brief note (1 page) entitled "Knowing Your Problems" I discussed issues with reference to a practical grounding in a microprocessor based project. This project has now run to the satisfaction of the original goal, that of programming an EPROM, but not quite to completion. I suppose software, even very complex software such as Microsoft Word, the tool I am using to write this, is often completed to the satisfaction of a goal but never finished. New ideas develop and new versions are designed and created. Even as a version is released, the next is being developed.
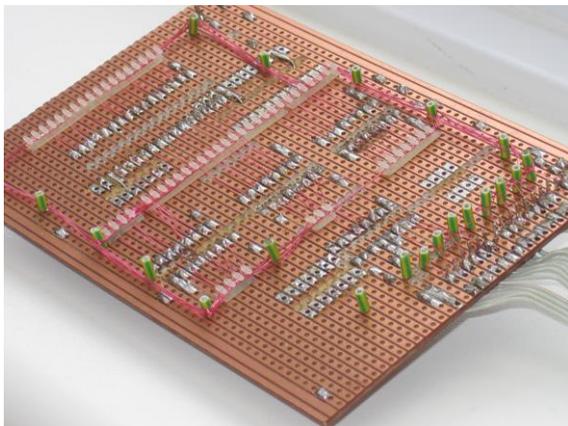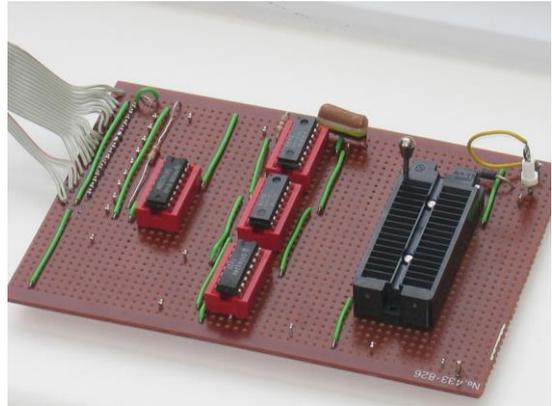


During this recent refocusing of attention, I became fascinated by the sort of mistakes that I made when doing the work. Admittedly, some of these could have been avoided through more rigorous planning but many were unpredictable and so simple that they were embarrassing. Before looking at reasons, explanations, lessons etc, it will be useful to consider some of the mistakes. They relate to microprocessor based hardware and software design and development but I will attempt to describe them in everyday terms. Incidentally, a brief search around 'concentration mistakes' seems to indicate that people assume that errors or mistakes are made when we do not concentrate. This is true. However, I propose that we also make mistakes because we are concentrating (or maybe it's just me). Here are some of my recent ones related to the project being discussed.

# Some Mistakes:

Whilst constructing the circuit board from a very basic design, carried out earlier the same day, I needed to place Integrated Circuit (chip) sockets on a circuit board and connect wires to and between various pins. The sockets that the chips would plug in to were on the top of the board and the wiring was to be placed underneath, the pins passing through a grid of holes in the board. The pins of each chip and their function can be identified from a data sheet and the design showed which pins of one chip to connect to which pins of another. The circuit diagram I had produced even showed this with lines representing the wires. So when the next task was to connect pin 6 of one chip to pin 17 of another chip, the operation was clear. However, the simple act of turning the board upside down to connect the wire cause me to connect to the wrong pins. I have done this correctly many times so why should I do it wrong now. It is fairly straightforward but I was concentrating on the wiring method at the time.



This mistake could have easily been avoided by providing a frame of reference on the reverse side of the board. But I should not have made the mistake even without one. The next mistake is not so easy to avoid.
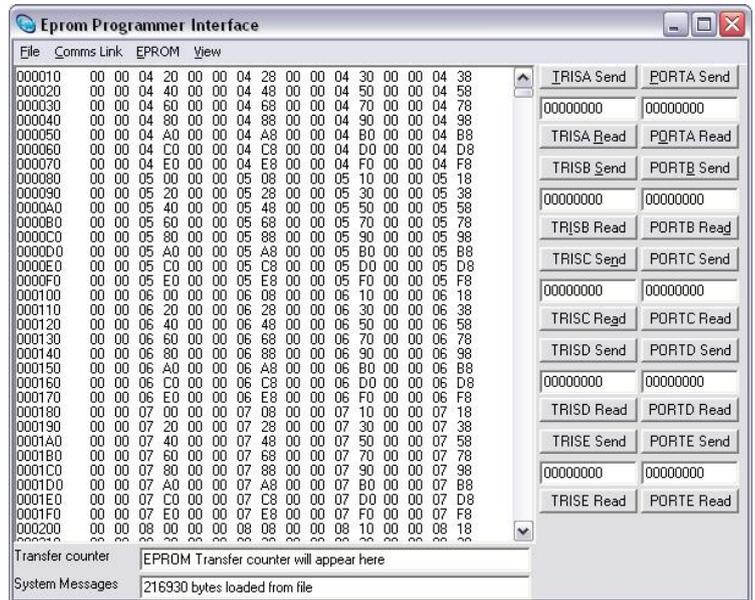


When I was writing the software (really called firmware because it stays semi permanently in a microprocessor called a PIC), I needed to describe in detail (in software code, 'C' in this case) what signal or voltage levels should exist on each pin of the EPROM (Erasable Programmable Read Only Memory) to be programmed at each point in time. Clearly I broke the task down into simple parts and concentrated on each part in turn. One part was to place one piece of information at one memory location in the EPROM. I had already written other parts of the program such as how to set up the address of the memory location etc. All I needed to do was to change a few voltages by controlling some of the microprocessor (PIC) registers at different times. I used a timing diagram from the EPROM data sheet to plan what to do and in what sequence. I followed the timing diagram and wrote simple commands to change each voltage

```
    set_address();      // set up the correct eprom address in latches
    TRISB = 0x00;       // port b is now write
    PORTB = byte;       // place the data on the data bus
    PORTD = 0xe8;       // lower the eprom enable bit
    PORTD = 0xa8;       // lower the program pin also
    eprom_delay();      // allow time for eprom to read data
    PORTD = 0xe8;       // raise the program pin
```

level when it was appropriate. All seemed fine. I had really concentrated on this. However, when testing, it did not work. The EPROM was programmed, but not with the data that I sent to it. On inspection, I had made a very stupid mistake. Whilst carefully concentrating on changing the voltage levels at the correct time, which was indeed done correctly, I had overlooked the very important point to actually present the data to the chip. The voltage levels did move correctly but there was no data. This was one very simple line of code missed out. But I can't really see how I missed something that important and more than that, why I did not see the mistake straight away?

There was also some software at the PC end of things (written in LISP). This was to deal with all of the data and communicate with the microprocessor (PIC) which contained all of the control instructions necessary to program the EPROM, but not much memory. So the PC was to do all of the data handling and user interface. When communicating between the PIC and the PC, I needed to work out some commands that each computer would understand, or rather that the software in each computer would understand.

I decided on a simple number representation for commands. There was to be one command byte (8 binary bits or 0 to 255 decimal) that would be sent at the start of each communication. The least significant bit of the command, representing 1 or 0, was to indicate whether this would be a read or a write operation. I had been using this in both ends of the software for a few days and had finally come to the point where I was to send the command to program the EPROM (in test conditions of course), a monumental step. I decided to do this along with a blank check command (to see if the EPROM is empty before I start) and a read EPROM command just to check things were working OK before committing to the final BURN (this is the name for programming the EPROM). When the code was ready, I tried out the read operation first because this was the least dangerous operation (less dangerous that BURN). When I sent the command, the PC did not receive any reply. I reset things and tried again, but no reply from the PIC. What I had done this time was sent a write when the command was to be read and a read when it was to be write. Again, so stupid but this time my concentration was on trying to make sure that the final BURN would work first time. In concentrating like this, I made a mistake that would ensure that it could not work.

I wish that I had exhausted my recollection of the mistakes that I made in this small project, but regrettably, I have not. However, to save further embarrassment, I will simply say that there were other mistakes similar in stupidity to the ones that I have described.

But why did I make those mistakes. Leaving aside the obvious comment that I am stupid, and what implications does an understanding of the making of such mistakes have for business, science, social and health services etc?

One thing I will say before continuing to consider why and so what, is that I do seem to get satisfaction from finding mistakes, fixing them and experiencing the working results; probably more satisfaction than doing it right the first time. Additionally, I feel that I gain benefit from this mistake, analysis and rectification process; more benefit that is, than doing it right first time. This point is worth returning to later.

## Why are the mistakes made?

Each of the mistakes discussed and more besides could have been avoided, as mistakes usually can be. Each of the mistakes were made during the enthusiastic pursuit of the realisation of an idea. Each of the mistakes were made whilst concentrating and focussing on activity rather than when being negligent. It may be true to say that the focus itself was off centre and the

concentration was not correctly aligned but the mistakes were not made without concentration and focus. Indeed the concentration and focus and the poor alignment and centring of these was possibly a significant factor in the making of the mistakes.

So I can't look back on the mistakes and say that they were inevitable, because they were not. I can't look back on them and suggest that I was not paying attention or interested in what I was doing. I need to look more carefully at my concentration and focus to find out why I made the mistakes.
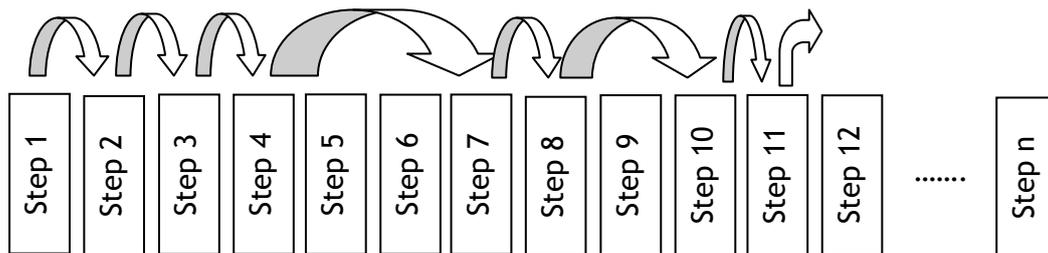
I also think that there was an additional contributing factor. This factor is or was, a desire to make progress rather than ponder the situation, a desire to get things done.
It seems then that enthusiasm, concentration, focus and a desire to get things done, are not enough to ensure that mistakes are avoided. Enthusiasm and a desire to get things done can mean that action is taken without enough preparatory thought. Misdirected focus and attention can leave other vulnerable areas exposed. It may be true to say that any fine focus and deep concentration can leave areas outside the target of the concentration, exposed.

Many mistakes are made because concentration or interest etc is missing, but it seems that mistakes can also be made when they are present.

Concentration is defined (elsewhere) as the ability to direct ones thinking. The human mind can, at times, carry out directed activity without thinking, where thinking is cognitive capability, generating ideas, analysis, imagination etc. Regrettably, many of us will have carried out fairly complex and focused activities whilst driving a car, without thinking. The human mind, at times, can be set upon a course of familiar action and simply get on with it. Mistakes made in this situation are not accessible to conscious awareness. I am not suggesting that, for instance, the software mistakes discussed above, were caused because my mind was set to work and left to get on with it whilst I thought about something else. Please forgive the use of 'my' and 'I' in this discussion, I know that I am confusing who I am in relation to mind, brain, body etc, at this stage, I feel that it helps to make the point. What I am suggesting is that this effect could be happening in miniature. I could be working on the code and then giving each bit of it, maybe single line, a thought and a push and then thinking about the next challenge whilst carrying out the more mechanistic parts of getting the code written.

Concentrate on each step   Skip over easy ones



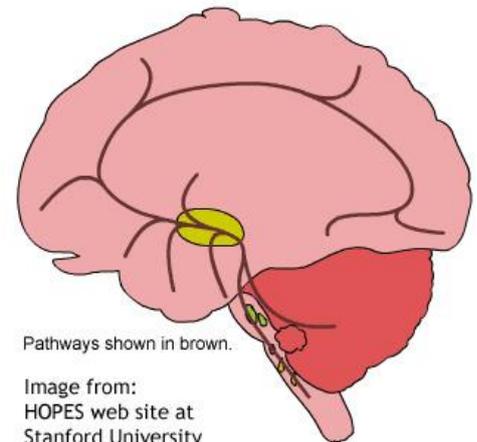| Step 1 | Step 2 | Step 3 | Step 4 | Step 5 | Step 6 | Step 7 | Step 8 | Step 9 | Step 10 | Step 11 | Step 12 | ....... | Step n |

In general, I am suggesting that I could have been thinking about the problem by sampling what look like the main components of it and then using my existing experience to fill in the gaps, possibly without too much deliberate thought. If this is true, then this is where the mistakes were made. I support this by suggesting that it is unlikely that I would give complete attention to every minute component part of the implementation of a resolution to the idea that I was developing. The things that looked obvious to me would be sort of fast forwarded so that I could concentrate more of the things that were less obvious.

There is still the issue of misdirected concentration. In the first mistake example, I stated that whilst I was deciding where to connect wires, I was actually concentrating on the method of wiring I was using, and getting that working correctly. The method was a wiring pen and comb guides together with a bit of make shift wire guide to route cables around the board. So the method used for the wiring itself required concentration, in particular to make sure that wires

were not damaged in certain places. The job I was doing however, was connecting the board component parts so that they made a circuit like the one that was designed.

Some may say that this is a failure to concentrate on more than one thing at once. I would probably accept this but suggest that people that say they can concentrate on many things at once, are sacrificing depth of concentration for breadth of coverage, admitting that some people are probably better at it than others. The deeper the concentration on something, the less mental capacity seems to be available for parallel thoughts. Shallow concentration does leave capacity for parallel thought. This is not De Bono's parallel thinking as in thinking along the same lines but intended to mean a single person dividing up thinking capacity to allow two (or more) parallel thought processes to take place simultaneously or split attention. Although I make these statements as though they are fact, they are not proven and are simply my views on the subject. Maslow (in Motivation and Personality) confuses the situation even more by pointing out that there are at least two sorts of attention. These are the deep and novel attention given to something new and the sort of attention that relies on our prior understanding and prejudices. It may be that split attention is more common in the latter than the former. It may also be that mistakes are more likely in the latter than the former. I suggest that it is likely that we use more of the latter sort of attention than the former and in this way, perhaps, create more openings for mistakes to be made.

In a summary of attention in 'Mapping the Mind', Rita Carter shows that an alert brain, according to a brain scanner, shows up as a very quiet brain. When the brain is giving full attention, the 'reticular activating system' in the brain, releases adrenaline that closes down unnecessary activity. This seems to support the idea that deep concentration is very focused (on one thing) whilst shallow concentration could allow several thoughts to be carried out in parallel.

It seems that Rita Carter is talking about the sort of attention that Maslow describes as deep and novel and that the other sort would probably lead to less focusing in the brain and possibly fewer other activities closed down. So mistakes may be made during this less well focused attention that relies on prior experience and prejudice but the former, deep and highly focused sort of attention may leave us prone to neglecting important external influences.

## What are the implications?
The implications of mistakes to a business, or health service or social service or military service etc, are more obvious to those involved with those services. But what are the implications of the possibility that mistakes are made through concentration, enthusiasm, focus etc?

One of the problems with making mistakes whilst focused and concentrating is that they can be difficult to see when the work is reviewed by the person that made the mistake. It can be that when that person examines the part where a mistake is, he or she sees the part as it should be, as he or she intended it to be and not as it actually is.

It can also be the case that a concentrating and focused individual (or maybe even team) will fail to notice mistakes that can occur through interaction with external objects and events. This has certainly been the case in many Information Technology projects where the focused IT team fails to see how the user will work with or interface with the technology. It could even be that the IT team fail to understand the working environment that the technology will be used to serve.

The implications of mistakes do not relate to the human capacity to make them, they relate to the consequences of the mistake. People can make mistakes at any level whether that is, not

stocking a supermarket shelf with the right product, or failing to warn an aeroplane pilot that he or she is currently on a collision course. The greater the consequences, the more checks need to be provided to avert the consequences of a mistake or ensure that mistakes are not made in the first place. Mistakes that people make can be very similar to each other, or at least the reasons that they are made can be very similar. However, the consequences can be very different.

It seems that whilst it is useful to consider mistakes and how to minimise them, the focus of attention should really be on consequences and the mitigation of these.

## What can be done about it?
I should point out that the mistakes that I have sighted as, perhaps, my own stupidity, were all non catastrophic. Nothing was damaged and nothing was lost except for some time. The reason for this is that I know that I make mistakes and I tested things before employing them for their intended role. I designed tests that would make sure that new parts of the design were working correctly at each stage of development. So one thing that can be done about mistakes, is to rigorously test things before they are brought into service. This is something that most organisations will already do. Having someone else check something is one way to help to prevent a mistake from causing its set of consequences although it may not prevent the mistake from being made. In some cases, even the checking process cannot disable all of the consequences. If an aeroplane part is manufactured incorrectly, checking is likely to prevent the most serious consequences but the incorrectly manufactured part will still cost the organisation something, even if this is a relatively small amount of time and money. More seriously, it could cause an order to be lost or a penalty payment to be become due. In this case, an organisation may wish to employ a more frequent checking system or even duplicate or triplicate the effort to reduce the likelihood of experiencing severe consequences.

The arguments earlier suggest, if not directly, that people must be more likely to make mistakes when they have to divide their attention too thinly or if they have to focus deeply on more than one important activity at one time. Efficiency in business often neglects to account for the fact that efficiency is to be delivered by human beings. Efficient working must take account of how human beings work best if it is to be effective. People are really good at many things but have their operational limitations. Even if the additional task must be done and the already overstretched person must also take on this new task, this does not mean that it will be completed successfully and it also means that the other tasks being carried out by the already overstretched person are in greater danger of failure. The problem with people is that they can often prove this wrong for short periods and perform extraordinary feats. They are unlikely to be able to sustain this however, and the point at which they fail to sustain it may be unpredictable and very serious.

One way that people can try to avoid making too many mistakes is through visualisation. It is very easy for the designer of a product, developing a design after all of the operating parameters have been set, to lose sight of how the product will be used when it is in service. This is because the designer will become focused on the problems associated with the design. If an issue arises with the design, the designer may focus more deeply on solving the associated problem without reference to how the product will be used. The software mistakes mentioned above were probably fewer because of visualisation and better visualisation may have avoided more of them. The Managing Director of a small manufacturing company told me that when a significant project was complete, ready for shipping, all of the staff in the factory, including office staff etc, were invited to the workshop to see it. This simple act would help the employees to visualise what they were doing things for. If an invoice total came to £75 for the last product to be shipped, the administrator may think that this was a rather small amount for such a significant product and discover that the correct figure should have been £75,000. Even though the next question may be, "How did that mistake occur?", the consequences of it would have been avoided.

## Is there any benefit in making mistakes?

Mistakes can take you to places that you may otherwise not go and the trip can be beneficial. There is not only me that thinks this. I have copied some quotations below from others that feel that people can benefit from mistakes. The last two from Niels Bohr and Ghandi respectively, seem to capture the essence of this point.

In the section on implications, I was looking at what effects mistakes may have on an organisation or the things that it is doing. But as Ghandi points out, there are implications if we strive to avoid mistakes and strive to help prevent others from making them. Niels Bohr even suggests that experts are the sum of their extensive mistakes.

Take a look at the quotations, and better still the web site. Even better, search for more information yourself. The conclusion that you may draw is that people need to make mistakes in order to grow (mentally). That does not mean that they should strive to make mistakes, they do not need to. If they strive to achieve, they will make mistakes by default.

Within this clear message is an un-stated and important point. Because mistakes can be beneficial, they should be looked upon as valuable. Don't give them away by asking someone else to sort them out. Invest in them and benefit from the learning and insight that takes place as a result.

## Quotes from:

chemistrycoach.com  (2015 - website original web site is no longer available – don't visit)
(at this time try http://www.quotationspage.com/)

I have reproduced a few of the many quotations found on the web site listed above because I feel that they are relevant to the content of this paper.

*Success is the ability to go from failure to failure without losing your enthusiasm. Winston Churchill*

*Not many people are willing to give failure a second opportunity. They fail once and it is all over. The bitter pill of failure is often more than most people can handle. If you are willing to accept failure and learn from it, if you are willing to consider failure as a blessing in disguise and bounce back, you have got the essential of harnessing one of the most powerful success forces. Joseph Sugarman*

*While one person hesitates because he feels inferior, another is busy making mistakes and becoming superior. Henry C. Link*

*An expert is a man who has made all the mistakes, which can be made, in a very narrow field. Niels Henrik David Bohr, (1885-1962)*

*Freedom is not worth having if it does not connote freedom to err. It passes my comprehension how human beings, be they ever so experienced and able, can delight in depriving other human beings of that precious right. Ghandi, 1931*

This last quotation seems to predict (from 1931) how we in the UK, will develop our education system and our work based training.

The web page has many more quotations that may inspire thought. I limited my copying to a few so as not to detract from the effort of the people that have compiled this list and deserve the credit for it.
For anyone with an interest in chemistry, you may find the rest of the web site to be quite useful.

## How can all of this be reconciled?

The problem of reconciliation for an organisation or even an individual, stems from the fact that mistakes generally have consequences. But we have also seen that there is a strong argument in favour of mistakes. The reconciliation has already been discussed. The problem may not be with the mistakes but with the consequences of them. Efforts need to be expended to avoid the consequences of mistakes whilst accepting that mistakes themselves are beneficial for an individual and an organisation.

Imagine an Aeroplane manufacturer trying to convince a very significant purchaser that the designers and engineers that make the aircraft never make mistakes. Any intelligent person would be justifiably suspicious of that claim. Imagine instead that the manufacturer tries to convince the would be purchaser that the aircraft company employs and develops the very best designers and engineers in the world. They all learn from their mistakes. The manufacturer then goes on to show that their system of checks and tests is so thorough that no mistake has ever got past it, yet the mistakes themselves have all been valuable developmental experience for the company. It may stretch the point to imagine that all mistakes have been recorded and the manufacturer boasts about how many there are and claims that this significant number means two things, that the organisation is learning, and that the checks and tests are indeed extremely thorough. Mind you, this is only being stated to make a point. Individuals generally seem reluctant to admit to mistakes and organisations seem to be acutely embarrassed about them.