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ARTÍCULO DE REVISIÓN

SOME NUMBERS WORTH KNOWING

ALGUNOS NÚMEROS RELEVANTES

RUDI COETZER*[1]

*** Correspondencia:**
Rudi.Coetzer@thedtgroup.org

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Este artículo de reflexión trata de explorar cómo los clínicos que trabajan en un mundo cada vez más complejo y orientado a los datos en la prestación de salud, interpretan, analizan, asimilan y difunden los datos numéricos que se encuentran habitualmente. Se sugiere que, en ocasiones, durante este proceso, pueden producirse errores involuntarios de razonamiento clínico y pensamiento crítico. El tema principal que se explora es cómo nosotros, como neuropsicólogos clínicos y parte del razonamiento clínico, comunicamos y procesamos la información, más específicamente los números, en nuestras propias mentes, como moneda de cambio para transmitir nuestras ideas, hallazgos, aprehensión, frustraciones o logros en nuestro respectivo trabajo clínico diario. Se utilizan ejemplos prácticos, basados en la práctica, para reflexionar y plantear preguntas sobre algunos de estos errores hipotéticos que podrían producirse. Los ejemplos de errores de razonamiento clínico y pensamiento crítico que se exploran en el documento incluyen los siguientes: No cuestionar críticamente la objetividad de los datos; una tendencia a la complejidad cuando se comunican los datos o los hallazgos clínicos, cuando la parsimonia podría proporcionar una explicación más transparente; ceguera ante situaciones en las que no hay pruebas para un argumento; la incapacidad de considerar hipótesis alternativas que podrían proporcionar una mejor explicación del fenómeno en cuestión. Se sugieren estrategias prácticas y psicológicamente informadas para evitar o minimizar estos errores. Se espera que este artículo estimule la reflexión y el cuestionamiento sobre un aspecto potencialmente "oculto" de nuestro papel como científicos y profesionales que trabajan en entornos sanitarios complejos, ajetreados y a veces abrumadores.

This reflective paper attempts to explore how clinicians working in an increasingly complex, data-driven world of healthcare provision, interpret, analyse, assimilate, and disseminate commonly encountered numerical data. It is suggested that on occasion during this process, unintentional errors of clinical reasoning and critical thinking may occur. The main theme explored is how we as clinical neuropsychologists, as part of clinical reasoning, communicate and process information, more specifically numbers, in our own minds, as a currency for conveying our ideas, findings, apprehension, frustrations, or achievements in our respective worlds of daily clinical work. Practical, practice-based examples are used to reflect on, and ask questions about some of these hypothetical errors that could potentially occur. The examples of errors of clinical reasoning and critical thinking explored in the paper include the following. A failure to critically question the objectivity of data. A tendency to default to complexity when communicating data or clinical findings, when parsimony could potentially provide a more transparent explanation. A 'blindness' to situations where an absence of evidence for an argument may exist. A failure to consider alternative hypotheses which could provide a better explanation of the phenomena under consideration. Practical, psychologically informed strategies to avoid or minimise these errors are suggested. It is hoped that the paper will stimulate further reflection and questioning about a potentially 'hidden' aspect of our role as scientist-practitioners working in complex, busy, and at times overwhelming, healthcare environments.

[1] The Disabilities Trust, Wakefield, UK. School of Human & Behavioural Science, Bangor University, UK. Faculty of Medicine, Health & Life Science, Swansea University, UK

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INTRODUCTION

'Brevity is the soul of numbers'

We need to talk about numbers. Numbers have been around for a long time and its use have recently enjoyed a resurgence during the pandemic. Epidemiologists suddenly became rock stars providing the public their daily 'chart hits' during the pandemic. We need numbers to make sense of things, manage our fears, or uncertainty, and to process information around us. Humans grow wiser by developing a deeper understanding of their experiences, and to achieve this, consciously or subconsciously make use of personal observations, statistics, and numbers (Rowntree, 2018). However, it should be made clear this paper is not about the details of mathematics, statistics, research, or data per se. It is primarily about critical thinking. Critical thinking, using the concept of numbers simply as the medium, rather than the specific topic.

How do numbers 'work'? Numbers confer credibility (perceived or real) to what is being said - after all, numbers are at the heart and soul of science, right? But numbers, or numerical concepts, are also used to process, and very briefly summarise thoughts, feelings, and behaviours. Maybe it is the brevity and perceived credibility of numbers in communicating complex, multi-layered information that is responsible for the at times disproportionate impact and potential to influence of numbers, positively or negatively. Which is exactly the reason why we need to talk about numbers. Hopefully this paper will help us consider the need to briefly pause when presented with (or before conveying an idea ourselves) any narrative with a number and consider a bit more critically what is being conveyed, and what the objective facts are. Not all numbers are equally precise, and some numbers might not even constitute anything numerical.

This intentionally provocative paper attempts to reflect on how we as clinical neuropsychologists and practitioner-scientists can possibly sometimes fall into the trap of disseminating, assimilating, and analysing informal, everyday numerical information in an age of data overload perhaps on occasion a little bit too uncritically. At its heart then this paper is about how we as neuropsychologists use numbers. The points made throughout the paper, consider through examples, the role of clinical reasoning, or critical thinking, and concludes with looking at some errors made in these areas, as well as suggest a few strategies to avoid errors. These errors of clinical reasoning and critical thinking include the failure to question, a preference for complexity when parsimony would provide a more transparent explanation, blindness to an absence of evidence, and not considering alternative hypotheses which could provide a better explanation of the phenomena being considered. It is hoped that the paper will stimulate debate, about how to be a little bit more questioning about how we think about numbers. More specifically, how we as clinical neuropsychologists, communicate and process information, in this case numbers, in our own minds, as a currency for conveying ideas, concerns, frustrations, or achievements in the world of daily clinical work, whilst avoiding making unintentional errors.

CRITICAL THINKING

'Is that a number I see before me?'

There is something mind boggling about numbers. On the one hand seemingly simple, on the other, deceptively complex. Imagine the cognitive leap the first human who counted something, maybe animals, must have made. Why are numbers so complex? Do they always accurately summarise what is being communicated by them – a measurable value? Let's use a hypothetical example from the clinical world of neuropsychology to take a closer look at what is meant here. A consultant neuropsychologist new to the role of consultant tells the supervisor that 'several things are wrong' in the unit or ward where he or she works. How many is 'several', and what is the impact of each? Maybe 7, perhaps 13, or maybe 2. 'Several' sounds like a number of course but isn't one (or even 1!).

Are there possible practical implications from the above example? Well, yes, the first question might be something along the lines of how many things are 'right'? From a clinician-academic perspective, think of a literature review or meta-analysis, the effect risk of bias can have on the result (findings and conclusions). Similarly, from a clinical leadership point of view, behaviourism still holds some utility, or at least explains some of the variance of patients' outcomes. One of the simple 'mantras' from behavioural approaches to change is 'If you want to increase desirable behaviour, reinforce what is working'. And in the context of this paper, we would want to add 'And measure it'. By employing useful numbers, numbers worth knowing. Numbers that tell us what a clinician, clinical team, or organisation, is doing, how often (frequency), for how

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long (duration), and even more importantly, what measurable outcomes these activities are achieving for patients.

Most neuropsychologists reading this paper by now would have undoubtedly recognised, is an unashamed reference to the landmark paper by the late Kevin Walsh, 'Some gnomes worth knowing' (Walsh, 1992). If there is one paper all neuropsychologists should read... In fact, this statement should include 're-read'. Since Walsh's seminal paper was published during the early 1990s, the use of data in managed healthcare and evidence-based practice has expanded so rapidly that numbers are now all around us. It doesn't matter if you work in private healthcare, state hospitals, or charitable health and social care providers, numbers increasingly underpin the management and clinical leadership in these organisations, including providers of neuropsychological rehabilitation. Let's now continue our journey to look at the often-hidden implications of automatically accepting all numbers at face value as clinicians, clinical leaders, and clinician-academics.

Here's our first example of well-intended, but most likely (at least in some situations) somewhat meaningless numbers: Psychotherapy sessions are fairly universally thought of as 60 minutes long - 'the therapeutic hour'. Why 60? Why not 45, 30, or 70? Where exactly in this number (60) is the patient considered? In an acute ward 60 minutes is almost always way too lengthy, whereas in post-acute outpatient neuropsychology follow-up clinics 60 minutes is often too little. Perhaps the 'therapeutic hour' is probably more tradition and convention, rather than an actual evidence-based number, or at least in neurorehabilitation settings? What is more important to consider in these settings, is to adapt session time to patients' needs, and more specifically to factors such as vulnerability to fatigue, problems with information processing, and poor working memory, among others (Coetzer, 2013; Judd & Wilson). Another example of how patient needs should dictate session time, would be the wise use of session frequency when working in slow stream rehabilitation, where low frequency of sessions is more likely to be the model of care, than the high session frequency immediately post-acute. Patient need rather than an odd number should inform care.

'IS THERE LUCK IN ODD NUMBERS?'

Some numbers are at best strange, and consequentially difficult to understand from within a clinical reasoning framework. When a number appears to have been arbitrarily chosen or hoped to accurately represent 'the best guess', it becomes difficult to determine its purpose. Here is a somewhat odd number loved and loathed in equal measures, depending on if one is a purchaser, or provider of managed healthcare. For example, we are often presented with a statement of 'fact' which states that a block of 12 sessions of cognitive behaviour therapy (CBT) is what this service always provides, or should be offering, to all patients. In this case, is there possibly a confusion between research trial design and data, with everyday clinical practice? Or is the predetermined number of sessions simply financially driven? There is huge variance between patients, as determined by their actual clinical needs, and where they are in their rehabilitation journey. For example, there is evidence that early rehabilitation, at a higher intensity, do positively affect patients' outcome after brain injury (E.g., Shiel, Burn, Henry et al, 2002).

Another common number that is often misunderstood, or more precisely, misinterpreted, is cut (-off) scores, especially in the context of self-report questionnaires. For example, it is stated that a patient scored 7 on a questionnaire for depression, where the cut score is 5. based on the score alone the interpretation is made that the patient is significantly depressed. Is that true? Well, he or she may be, but it depends on several factors. Can we be sure of the validity or reliability of the responses of a patient with a traumatic brain injury, where there may be working memory difficulties and impairment of executive functions? For example, the patient may repeat exactly the same response to all items of a test, as a result of poor memory, perseveration, or impulsivity. Or maybe the patient has poor self-awareness. Furthermore, a few of the listed ICD or DSM diagnostic criteria for depression overlap with the core impairments stemming from traumatic brain injury (Coetzer, 2010), for example poor concentration, insomnia, or loss of appetite (sometimes due to anosmia). What exactly explains the patient's numerical score?

Interestingly, when self-report questionnaire data are contrasted with neuropsychological test data, the differences in subjective vs. objective numbers can for some be significant. For example, in a study by Bowler, Adams, Schwarzer and colleagues (2017) comparing participants' self-reported memory problems, found that the association with neuropsychological test data was not always straight forward, and that there was not a perfect correlation between self-reported memory problems and memory test results. Clearly,

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the interpretation of numbers, including cut scores, derived from individuals' self-report, is complex. However, are the results any better when rather than individuals participating in research, experts pool their views or answers to questions? Below follows a hypothetical example to consider the complexities of these expert panel generated numbers.

An expert working party tasked with improving clinical care in stroke services after considering all members' views, publish their consensus report. One of the (numerous) recommendations is that there should be 2 neuropsychologists for every ward of 20 or more hospital beds. This seems like a credible recommendation, and most neuropsychologists would hopefully be delighted to embrace this conclusion. But wait, there is a number missing! Will there be funding attached to providing these 2 posts? And, while we are on the number 2, does it capture the whole truth of what's required in this clinical environment? Maybe, but it will depend on what these 2 neuropsychologists do on a day-to-day basis. Providing direct patient care, yes, the mathematics show that each can cover 10 beds over a 5-day rolling period. Doing primarily non-direct patient work, it is difficult to understand the numbers and value added, never mind outcomes for patients.

Related to the above example, there is a potentially hidden suspect, which is about the number 1. Philosophically 1 almost isn't a number, as it doesn't really count anything. The number 1 metaphorically speaking has two main friends, binary maths, and nominal (or categorical) data in statistics (Chi square). To return to the above example, if a neuropsychologist works from a standpoint of 'one patient seen perfectly = perfection of clinical practice', this can have a profound impact on throughput. How lucky must the number 1 be for the neuropsychologist in this case - only 1 patient to see, with the added luxury of lots of time to do more than what is needed! However, epidemiology – and the neuropsychologist's poor colleagues picking up the rest of the referrals or waiting list - will almost certainly disagree with this way of thinking about typical case numbers per clinician. Not to mention the hospital manager responsible for performance and patient throughput. But if still in doubt, think about, and reflect on what is captured in statistics by averages, medians, standard deviations, and outliers, and why this matter.

'THINKING (ABOUT NUMBERS) IS FREE'

A neuropsychologist is asked to assess a patient who is reported to have suffered a traumatic brain injury following an accident at work. The neuropsychologist is told by the employer that the patient was unconscious for 3 months and is now, 7 months after the injury, ready to return to full-time work. While this may be possible, it is perhaps unlikely based on what we know about a fairly large body of research about markers of severity and early outcome after traumatic brain injury. For example, Ruet, Jourdan, Bayen et al (2018) found that there is a significant association between numerical clinical markers of increased injury severity and poor employment outcome after traumatic brain injury. Crucial here is to confirm the length of period of loss of consciousness, by for example reading the patient's hospital medical notes. Narrative remains narrative (subjective) irrespective of the number (s) quoted therein, until data confirms it as objective, meaning and actual number(s). Thinking about and considering what the precise numbers are in each case, costs nothing, and is good practice to ensure the best care for patients.

Is there strength in numbers? More specifically, group thinking. This depends on the size of the group, or statistically speaking the N, or sample size, one of the cornerstones of increasing confidence of findings. For the purpose of providing an example, let's say a small group (say about 10, or the approximate size of a jury) consider appeals after rejected applications for disability support. After debating the case, the majority (say 8) agree that the applicant (a patient of a neuropsychologist) sustained a severe traumatic brain injury, but also conclude that the person is fit for work and therefor only entitled to a 30% payment of a medical pension, or state disability allowance. A fundamental question here is how likely it is that a sample size of 10 people not posing any specialist knowledge about traumatic brain injury would be large enough to achieve statistical significance (or confidence) to ensure that their conclusion is numerically accurate? Neuropsychologists have a professional duty to advocate for their patients, and present factual data (numbers) representing the severity of their injury and disability, to prevent our patients from receiving compensation, state support or judgements potentially based on opinion, as opposed to objective data.

'UNEASY LIES THE NUMBER THAT WEARS A CROWN'

For clinicians and clinical academics, some of the more tricky numbers to understand are those received from senior management, for example contained in corporate policies. Take this hypothetical example to illustrate the point. A healthcare organisation caring for neurological

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patients decides that every new admission should have a set of 5 questionnaires and screening instruments administered, before concluding the assessment with a standardised neuropsychological battery consisting of a battery of 7 tests. This rigid approach to produce a predetermined dataset of numbers assume that there are no differences between individual patients and their respective impairments, never mind the differences between the clinical profiles of traumatic brain injury, stroke, brain infections and so forth. Now add demographics such as patients' age, pre-morbid education, time since injury and injury severity, and the fixed number of assessments approach just doesn't add up anymore. Indeed, the deductive hypothesis testing approach (see e.g. Larabee, 2012, for a description) in neuropsychology posits that individualised assessment (and per implication, rehabilitation) is possibly 'king'.

Similarly, take the following scenario where a neuropsychologist is the senior member of a multi-disciplinary team. For the sake of the example, say that the average length of training as a neuropsychologist is between 8 and 10 years. Furthermore, for the sake of this hypothetical example, there are 10 hours of lectures or academic assignments per week (it is likely much higher), for 8 of the 12 months per year (4 months are holidays). The end result of this extended and comprehensive training is an integration of complex, unique skills and knowledge. Now, the multi-disciplinary team all see patients as a core component of their professional practice. Except the neuropsychologist, who spends the majority of his or her time, providing supervision or training to others, so that they can do...

... the tasks the neuropsychologist can, by virtue of their training almost certainly perform more effectively.

Of course, there is absolutely a place for supporting other professions to develop basic neuropsychology skills, but perhaps not as one of the main components of a frontline clinician's role. The numbers just don't add up. If we dispassionately consider the numbers (training hours, cost to the state or universities, etc.) of the average neuropsychologist's training, the neuropsychologist would have to provide an awful lot of supervision and training hours to make up for that investment. Furthermore, swing this argument around, and try to think of the last time a physiotherapist, doctor, or occupational therapist, as a core component of their roles, provided supervision or training to neuropsychologists, for neuropsychologists to perform key aspects of these professions... Perhaps more importantly even than the purely hypothetical numbers in this example, is the philosophical question a colleague recently asked - if it is indeed so complex and lengthy to train as neuropsychologist, how can these skills and knowledge be transferred so easily within a minuscule fraction of the time required to acquire these skills and knowledge in the first place?

'LISTEN TO MANY, SPEAK ABOUT A FEW'

To have impact, numbers should ideally be simple to understand for anyone, but at the same time not become so diluted that they become totally meaningless. Often numbers summarise large, complex datasets. Like the power of numbers to capture multiple layers of information, similarly Shakespeare's prose is beautiful too in both its complexity, and simplicity. Take for example the lines 'I am as true as truth's simplicity, and simpler than the infancy of truth' (William Shakespeare, Troilus and Cressida, 1602). Furthermore, Latin, similar to numbers, also has the power to capture vast meaning. But both though can also sometimes 'hide', rather than 'reveal' what needs to be communicated to certain audiences. Why, when speaking to an audience other than legal professionals, use the term *causal nexus* when instead using 'the most likely cause of this (effect) was...' would make it clear what was being said? Simplicity is probably closer to the truth, or essence of what is being communicated.

Numbers, like Latin, can sometimes also make complex data or concepts impenetrable and nebulous for some audiences. Using numbers wisely has the power to possibly democratise science and facilitate access to some of the complex concepts of clinical neuropsychology. Ideally anyone should be able to understand the fundamental truths of what is being communicated, and what the numbers quoted to evidence these mean. For example, using simple, non-technical language when providing feedback to patients and relatives following neuropsychological assessment, can help ensure that the key messages are understood. The ability to make simple what is complex is a skill that requires 'listening' to a large amount of numerical data, but to 'speak' only about the headlines, or conclusions. A good example of what is meant here, is to look at how outcome reports, or the annual reports of health and social care organisations are written.

Although outcome data generally tend to capture complex numerical information, how these data (or numbers) are communicated should ideally be easy to understand.

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Most people know what a percentage is and what it means. For example, rather than report the details of statistical significance, range, confidence intervals, averages, percentiles, z scores, and standard deviations of patients' outcome over a finely graded list of post-rehab destinations, how about '45% of our patients were discharged to less restrictive settings during 2022' as a headline? The former detailed, statistically sound data are for a professional journal, and are excellent for that audience, but need to be made more accessible for reports intended for readers who want to know, in simple terms, what happened to a hospital's patients. Less can sometimes be closer to the truth.

DISCUSSION

'All that glitters is not a number'

Data are the gold of our time. One of the core ideas presented in this paper, was that some 'numbers' are not numbers which are possible to meaningfully measure, or data amenable to objective comparison, but that some numbers we are presented with can rather be seen as adjectives used to convey subjective emotions, thoughts, and perceptions. Neuropsychologists, almost certainly just like other healthcare professionals, perhaps unintentionally or even subconsciously commit errors of clinical reason when we fail to critically appraise numerical data. Numbers and statistics make it possible for us to summarize data, compare findings, make sense of what it means and predict more accurately than we would be able to in our everyday conversations (Rowntree, 2018). This paper intended to highlight common errors and stimulate critical thinking. The skill to question narratives containing numbers can potentially have some benefits for the clinical training of future practitioners, the provision of patient care, and developing clinically informed leadership of healthcare organisations specialising in the care of neurological patients.

The common errors of clinical reasoning and critical thinking throughout the examples presented in this paper included the following. The first is a failure to question (or automatic acceptance of 'facts'). A useful strategy here is almost similar to the classic CBT exercise of finding the evidence (or absence thereof) for thoughts. An even simpler strategy is to use the mantra of always reminding ourselves of what the difference between 'objective' and 'subjective' is. For example, when reading a clinical report or listening to what is being presented, try to think about what is an unequivocal fact (a Glasgow Coma Score or 7/15 for 3 days in the medical notes), versus narrative ('I was unconscious for a couple of hours'), hearsay evidence ('someone said they saw him walking around after the crash'), or a third party's opinion ('he doesn't have a brain injury, he's just seeking compensation'). The second error in some of the examples is the almost automatic preference for complexity when parsimony could provide a more transparent explanation or facilitate better communication. When explaining something to patients, families, or non-neuropsychologists, stop, pause, and first mentally do the age-old psychotherapy exercise or role reversal. Ask the question, if I were the patient, or a member of a lay audience, truthfully, would I understand the core messages being conveyed to me?

The third common error is the mirror image of the famous quote of 'absence of evidence is not evidence of absence' (unknown): blindness to an absence of evidence. One way to think about how to avoid this error, is perhaps more psychodynamic or psychoanalytic in nature. It is likely that this type of error is made more subconsciously. Being more aware of how emotions effect our decisions may be helpful. The sense that 'something doesn't feel quite right' shouldn't be ignored. If it doesn't feel right, it probably isn't, may be a useful mantra to remember. A more cognitive strategy might be to ask the question, 'if this were to be presented in court to a judge, what will the sentence be?'... The fourth, and final error, was failing to consider alternative hypotheses which could potentially provide a better explanation of the phenomena being considered. As scientist-practitioners, neuropsychologists are well placed to avoid this error by asking themselves if what is being presented as the facts, would be possible to write up as a state-of-the-art literature review for a peer reviewed journal, and what he outcome of the review will be. It is hoped that the outcome of the present paper will be that some of the ideas presented here will stimulate further debate around the role of critical thinking and clinical reasoning to prevent data, the gold of our time, from becoming fool's gold.

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