4

The Dimensional Model of Personality and Psychopathology

Revisiting Eysenck (1944)

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BACKGROUND TO THE STUDY

Personality researchers had long been troubled by the sheer complexity of the field. This is seen in the proliferation of concepts, constructs and measurement scales to describe the many ways in which people differ from one another. This state of affairs has made difficult the task of relating normal variations in personality with related abnormal, clinical conditions. Such is the extent of the problem, it has even been argued that not only is personality complex but it is too nebulous a concept to be measured in any sensible fashion; and most certainly not readily, or sensibly, reduced to only a small number of factors or dimensions – Hans Eysenck was not one to share this view. Eysenck's 1944 classic study led the charge to make a number of significant advances that changed our notions of the fundamental nature of personality, especially how it relates the pattern of normal variations in the general population to clinical conditions ('psychopathology', more generally). Looking back over the past seven decades, his work is seen to be transformative and is now to be found in current scientific models of personality and psychopathology (O'Connor, 2008).

What stands out in Eysenck's 1944 work are four key tipping points in psychological thinking. First, the main aspects of personality can be reduced to a small number of dimensions, as identified and described by statistical analysis. Secondly, the (apparent) complexity of personality can be understood with reference to how people stand on these dimensions – even with only a few dimensions, there are a very large number of possible personality configurations that define the individual (in a similar fashion, we perceive a wide variety of colours, yet we have only three types of colour receptors in the eye – it is the complex information that comes from their *joint* activation that is of importance). Thirdly, personality dimensions are probabilistic functions that predict clinical disorders; and personal attributes link to specific clinical behaviours in a systematic fashion – in other words, why does *this* person react with these symptoms to the same event (discussed further below). Fourthly, experimental

research as well as psychometrics, especially entailing biological variables, is needed to explain both personality and clinical disorder.

Around the time of the work in the early 1940s that went into Eysenck's 1944 classic study, other notable researchers were attempting to impose statistical order on the numerous descriptive approaches to personality. Preeminent here was Raymond B. Cattell, who made seminal and lasting contributions to personality psychology (see Chapter 3), although unlike Eysenck, Cattell preferred many more factors of personality, as shown by his Sixteen Personality Factor (16PF) model. But unlike Cattell, Eysenck's approach was always inspired by and focused on clinical disorder – for this reason, it is a mistake to mischaracterize Eysenck's personality work as purely statistical in nature (statistics was a means to an end and not the end in itself).

As we see in Chapters 1 and 2 of this volume, during the early years of the 20th century attempts were made to identify the main factors of personality and impose some order. This work eventually led to the development of various (statistically derived) trait models of personality, the most prominent today being the Big Five (see Chapter 5). But, none of these *descriptive* approaches addressed what Eysenck uniquely identified as missing in the field: over the next 50 years of his life, he advanced our understanding of the *underlying* psychological and physiological *causal* basis of personality, and extended the implications of these causes to all areas of psychological life (e.g., crime, sex, marriage, work, health, and even parapsychology; see Corr, 2016a).

But in the early 1940s, Eysenck's tipping points were, indeed, novel and bold. Whilst he was trying to put the study of behaviour on a scientific footing, we should remember that Medical Psychiatry was still touting a number of quack treatments with no proven scientific basis – and little theoretical rationale. These were largely derived from personal hunches and serendipitous observations, some of which would not be out of place in a chamber of horrors. Yet Psychiatry was happy to endorse them up until the 1960s. Amongst others that could be mentioned, these included insulin-induced coma therapy (discovered as a result of a chance dosing error) and seizure-induced therapy (inspired by watching pig stunning in an abattoir). In the 1940s, Walter Freeman was touring America with his 'lobomobile' offering onsite frontal lobotomies (for which Egon Moniz earned the Nobel prize in 1949) disabling frontal lobes with a hand-held ice pick. A more psychologically informed perspective in psychiatry was badly needed, and Eysenck set his mind to this task.

Eysenck and 'The London School'

The intellectual background to Eysenck's early work may easily be traced to his education at University College London (UCL), in the mid-to-late 1930s (after he left Germany in 1934 at the age of 18 because he detested Hitler and all he stood for). At that time, UCL was renowned for its individual differences research, especially intelligence (many of the ideas and statistical techniques Eysenck extended to personality psychology had their roots in this very work).

As detailed by Corr (2016a), by the time Eysenck entered UCL in 1935, Sir Francis Galton and Charles Spearman were the ghosts of science past but their work lived on in Cyril Burt – he was later to be knighted in 1946 for his services to educational psychology – who greatly influenced Eysenck. In a short space of time, the young and eager Eysenck was to become the most prominent member of 'The London School' (Eysenck, 1997), so-called to differentiate it from 'The Cambridge School' which focussed on experimental psychology and had relatively little time for correlational psychology of the kind favoured by Galton, Spearman, Burt and Eysenck.

Starting in these early war-torn days, throughout his long and highly productive life, Eysenck set himself two principal objectives: first, to provide an adequate statistical description of *how* people differ from one other on basic dimensions of affect, thinking and behaviour (i.e., 'personality'); and secondly, to search for a causal explanation of *why* these differences existed in the first place and, by so doing it was hoped, explain the vulnerability of certain personality types to clinical (both neurotic and psychotic) disorder – indeed, Eysenck wanted to explain all forms of behaviour (e.g., sexual and marital satisfaction), especially criminal behaviour (something he called *sociopsychiatric* behaviour).

It would be useful to know something of the circumstances of Eysenck's life during the conduct of the research that went into his 1944 classic study. Following the award of his PhD, during the early 1940s, and after a short stint in the Air Raid Precautions (ARP) in Islington, North London, Eysenck served as an assistant psychologist at the Mill Hill Emergency Hospital, north of London, where he had access to patients and their clinical records (due to his status as an enemy 'alien' during World War II he was ineligible for military service). He saw the chance of making a significant contribution to psychology and he took it – freed of important, if tedious, war work, fortunately for Eysenck, he was one of the few bright young psychologists who had such a splendid personal opportunity of so doing at that time.

As part of his much wider psychological perspective, Eysenck saw personality as being fundamental in a number of ways. He believed that people have innate predispositions that determine how they react to the *same* environmental stimulus (or complex configuration of stimuli; i.e., the 'situation', or more loosely the 'event'). Secondly, traits are not static in their effects: they are predispositions to react to stimuli in certain, often complex, ways and they do not simply predict specific behaviours in all situations. Eysenck assumed that these features lead some people to be especially vulnerable to clinical disorder, while others are more prone to criminal behaviours. To his mind, personality was central to psychiatry. This view was endorsed by the words of the most foremost psychiatrist at that time, Sir Aubrey Lewis, who wrote in his Foreword to Eysenck's (1947) first book, *Dimensions of Personality*:

> Personality is so cardinal a matter in psychiatry, that any ambiguity in the concept or uncertainty about how to describe and measure the qualities it stands for, must weaken the whole structure of psychiatry, theoretical and clinical.

DETAILED DESCRIPTION OF THE STUDY

Eysenck's 1944 classic study was published in the *Journal of Mental Science*. Out of this study came the widespread acceptance of the personality dimensions of Extraversion (E) and Neuroticism (N) – in 1952, he added a third dimension, Psychoticism (P), which opposed the Freudian notion that neuroticism is on the same dimension as psychosis, with the hinterland between the two occupied by the 'borderline personality'.

Theory

Starting off his 1944 paper, somewhat tongue-in-cheek, Eysenck noted that few psychologists and psychiatrists would dissent from the view that the field of personality is in a 'state of acute conflict and dissociation', and this was true also of the psychiatric field of classification and diagnosis of mental disorders. At the beginning of his paper and instructive of his whole approach which is evident so early on, Eysenck informed the reader that his theoretical basis is that neurosis is a failure of adaptation, which is the result of two components: 'constitution' and the 'environmental set-up of the moment'. Coupled with the idea that normality and abnormality are merely different points on the same dimension, according to Eysenck, it follows that the study of the symptoms of neurotic patients should reveal the structure of traits found in the general population: they are *writ large* in clinical (maladaptive) samples.

Eysenck was very familiar with the statistical technique of factor analysis, which had been pioneered by Charles Spearman at UCL specifically for the purpose of uncovering the structure of intelligence (divided into its general, *g*, and specific, *s*, components, such a performance, verbal, numerical, and so on). Although a complex statistical technique, factor analysis has a simple aim: to take a large set of intercorrelations – in this case, between 39 items on a medical checklist – and to reduce them to the minimum number of axes (or 'factors' – mathematical descriptions) that account for the shared 'common' variance between the items (all items have their own 'specific' variance and as this is not related to the variance of other items, this is ignored in 'common' factor analysis). Factor analysis aims for statistical parsimony with the hope of resulting theoretical elegance.

In his 1944 paper, and showcasing his distinctive approach, Eysenck highlighted several merits of his dataset over previous studies, which he said suffered from: small numbers of subjects; the biased method of selection of subjects; the small number of items which were not sufficiently large to allow the identification of factors with any confidence; raters untrained in the administration of test items; failure to consider such confounding factors as 'halo' effects (i.e., over-generalizing from one positive feature; and other forms of response bias, including confirming biases); and, all of this was made worse by the lack of care in providing a psychological interpretation of factors despite the sometimes great care taken over the mathematical aspects of these studies.

Methodology

Eysenck was truly fortunate to have landed the opportunity to access the records of some 1000 patients – who, it should be noted, mentally broke down during initial military training and not on operational duties or in battle. From this pool, he selected 700 patients (excluded are those with various form of organic brain injury, disease of the central nervous system, physical issues, epilepsy and 'cases in whose illness psychological causes were unimportant'). The final sample comprised neurotic male soldiers referred to the Mill Hill Emergency Hospital (North London), assumed to have a 'reactive' type of neurosis – that is, a 'failure of adaptation', as Eysenck saw it. The final sample was a rather mixed bunch, and specifically not equated on diagnosis, for example depression, anxiety, or psychopathy. One pleasing feature of the medical checklist is that it was completed by several psychiatrists which enhanced its reliability; as Eysenck noted: 'the ratings were made, not by one psychiatrist, but by over a dozen all different in their theoretical leanings' – this was made possible because the patients in his sample had 'successive admissions', which suggests that they had a chronic inability to adapt to the environment.

Eysenck took 39 items from 'some' 200 items recorded for each patient (some of these 39 items are shown below). They are scored on a variety of ordinal level scales (as shown below in italics).

Q. 4 '*Work history degraded, or unduly frequent changes of occupation vs. study work history*'

Q. 9 'Hobbies and interests' – *narrow vs. broad*

Q.13 'Weak, dependent, timorous personality' – *somewhat or very vs. not*

Q.14 'Drive and energy' – *inert, without initiative vs. average go or conspicuous energy*

Q. 20 'Fatigue, lassitude, effort intolerance' – *yes or no*

Q. 22 'Fainting fits' – *yes or no*

Q. 23 'Pain – not of demonstrable organic origin and excluding headaches' – *yes or no*

Q. 25 'Sexual anomalies (impotence, ejac. praecox, masturbation worries. Homo-sexuality, others)' – *yes or no*

Q. 31 'Anxiety, anxiety dreams, battle dreams' – *moderate or severe vs. none or mild*

Q. 32 'Depression' – *moderate or severe vs. none or mild*

Q. 34 'Hysterical conversion symptoms (motor, sensory, special senses, visceral or other)' – *any vs. none*

Q. 38 'Intelligence' – *below average vs. average or above*

Eysenck based his selection of items on two criteria. First, they had psychological meaning (at least in terms of adaptation to the environment). Secondly, they were found in more than 10%, but less than 90%, of patients – otherwise there would have been the statistical problem of 'range restriction' of the items. It is obvious that many of these items are objective, for example intelligence test scores, work histories, marital status, and so on. This meant that they were not contaminated by pre-existing psychiatric notions regarding clinical conditions – as Eysenck put it: 'Diagnoses, being of little objective value, were not included in the analysis'. Ratings by psychiatrists were informed by a number of sources, including relatives of the patients and nurses so Eysenck could have confidence in the accuracy of them. The binary nature of the response format helped Eysenck to reduce the biases inherent in the assessment of more subjective symptoms by psychiatrists; however, it also served to complicate the factor analysis and this led to criticisms, which we discuss below.

Findings

Following a very laborious manual factor analysis, Eysenck reported finding four factors in the data, but he decided to focus on only two of them. Factor one was defined by 'badly organized personality', identified by him as 'Quite clearly, the factor is one of neuroticism' or 'lack of personality integration'. The second, bipolar, factor dichotomized anxiety/depression/obsessions and hysterical attitude (which people have referred to as 'acting out'). Quoting Jung, Eysenck concluded: 'The hysteric belongs to the type of Extraversion, the psychasthenic to the type of Introversion' and 'we consider this bipolar "type" factor to be identical with the introvert–extravert dichotomy.'

The respective Neuroticism and Extraversion factors Eysenck identified in this analysis were interpreted in line with previous theoretical speculation, especially Jung's work which related Extraversion (and its opposite pole, Introversion) to clusters of major neurotic disorders (Extraversion: externalizing, 'acting-out', disorders; Introversion: internalizing disorders, e.g., fear/anxiety). It is noteworthy that during these very early days, Eysenck wrote: 'we consider this bipolar "type" factor to be identical with the introvert–extravert dichotomy with … Pavlov's concept of "inhibition"'. Eysenck was to make great use of Pavlov's notions of inhibition and excitation in his first, 1957, biological model of personality, *The Dynamics of Anxiety and Hysteria: An Experimental Application of Modern Learning Theory to Psychiatry*. (The title of this book captures well Eysenck's theoretical orientation – and the 'dynamics' may well hark back to Eysenck's first scientific love, physics.)

The lesser, third, factor Eysenck called 'Hypochondriasis', which he considered, for reasons not given, of little general theoretical interest. Regarding the fourth and last factor, in a rather forthright manner characteristic of the times, Eysenck

noted it 'distinguishes between the stupid, drunken, shiftless social misfit on the one hand and the "psychological conflict" group on the other' – this factor might bear some resemblance to Eysenck's 'Psychoticism' factor that he identified in 1952, but in 1944 he did not pay it any further attention.

In interpreting the first two factors, Eysenck was at pains to acknowledge past research which provided him with much of the theoretical basis for their interpretation, which included the ideas of Freud, Jung and Pavlov. In this way, Eysenck was not left to interpret the statistical factors in a theoretical vacuum – this point is often overlooked when assessing his work.

IMPACT OF THE STUDY

At this point, it is important to note that Eysenck did not invent or discover extraversion or neuroticism – in different guises, they were known well before his time. But what his classic study did was to bring them to the forefront of research psychiatry and offered a way to understand the underlying psychological 'dynamics' by reference to experimental means of personality and psychopathology in the normal population. His approach was important, too, for inspiring other psychologists to pursue similar lines of research (see Chapter 7). It may be said with little fear of contradiction that as a direct result of Eysenck's thinking, theorizing, researching and popularizing, today we have a neuroscience of personality which not too many years ago was seen as something of an oxymoron, and a laughable one at that (especially when it was suggested that non-human animals have personalities too!). Times change, and in personality psychology they most certainly have. In all of these developments, Eysenck was highly influential in arguing for the need to relate normal variations in personality dimensions to clinical disorder, especially as it had long been suspected that personality and psychopathology are cut from much the same scientific cloth. Eysenck's 1944 study was the start of a revolution in this field, and it is rightly regarded as a classic.

Eysenck's 1944 classic study had an immediate impact and it was followed up in book form in 1947 with *Dimensions of Personality*, in which Extraversion and Neuroticism are sharpened up as statistical factors and, importantly, related to experimental variables that started to get closer to the causal underpinnings of them. This study and those that followed allowed Eysenck to press home the advantage of advocating a dimensional approach over a purely categorical one favoured by psychiatry – Eysenck long argued that this 'medical model' is not only an inaccurate depiction of the nature of psychological disorder, but a harmful one that impeded the development of a truly scientific clinical psychiatry.

Methodology

It is remarkable how many of the themes that characterize scientific Clinical Psychology today were either present or hinted at in Eysenck's 1944 classic study. Aside from the general aim of giving order and coherence to diverse personal

attributes through the use of the advanced statistical technique of factor analysis, in his scientific rigour Eysenck foresaw practically all of the psychometric considerations required for constructing valid measurement instruments: test–retest reliability, internal consistency and external validity – ensuring that instruments (e.g., personality questionnaires or psychiatric rating) are consistent in measurement and related to the construct they purport to measure. Eysenck also foresaw the importance of eliminating subjective bias in ratings, which he did by estimating inter-rater reliability – which he did not publish because this reliability was so low – and he recognized such important issues as sample selection bias and observer bias (see MacCoun, 1998). Of no small importance, Eysenck also used intelligence tests as a way of controlling for cognitive ability as a confounding factor in personality assessment.

The overall implication of Eysenck's 1944 classic study is that clinical work can be linked with rigorous and reliable observation and, furthermore, statistics is a way of resolving clinical ambiguities – not all were in agreement with him at that time, but now most are. In his conclusions, Eysenck emphasized the importance of using objective tests to continue the process of construct validation: what is the test truly measuring? Important here were experimental measures, which can start to get at the causal basis of personality (e.g., ease of classical conditioning). These scientific checks and balances are now the gold standard in psychological assessment and *de rigueur* in any quality scientific paper – they were borne out of Eysenck's incisive research, which sometimes was met with opposition and, even outright hostility (see Corr, 2016a, 2016b, 2016c).

Another concern throughout Eysenck's 1944 classic study, which was embedded in its rationale, is the importance of applying rigorous methods to real life 'messy' problems. At the time, Eysenck was writing against a backdrop of increased interest and experimental activity in the evolving discipline of clinical behaviourism – such theories were bearing fruit on the importance of conditioned learned associations and reinforcement schedules in guiding behaviour. But much of the evidence came from laboratory studies on experimental animals (rats and pigeons) and the extent of their implications for humans were, at best, unclear and, often, contested. Eysenck was, of course, very aware of these developments and was edging towards the foundations of Behaviour Therapy, but one based on the direct study of the human animal. But, seemingly unlike other behaviourally inclined research psychologists, Eysenck was in the real world and so saw how important it was to measure human personality traits, especially those useful in identifying individual differences in the psychological processes behind clinical behaviour. He was quick to locate the organism (the person) between the stimulus (S) and the response (R) within the well-known sequence: S–O–R instead of S–R; in the 'O' resided individual differences in personality, broadly defined. Much of Eysenck's later work would focus exactly on such individual differences mediating learned behaviour. Elsewhere Joseph Wolpe, in fact, attributes the later promulgation and acceptance of behaviour therapy largely to Eysenck (Wolpe, 1973, pp. xi) – Eysenck's role in the establishment of behaviour therapy, and clinical psychology more generally, cannot be seriously questioned (see Corr, 2016a).

Behaviour as a dimension, not a category

It is important to place Eysenck's dimensional approach in the context of the common psychiatric approach, at the time and still enduring, of classifying by exclusive categories. Such categories are usually the result of consensus and committees, and are not based on actual empirical (experimental or clinical) evidence; consequently they have little, except superficial face, validity. As is well documented, diagnostic categories often change with the political climate rather than facts: dogma over data. In contrast, Eysenck's dimensional approach achieves the following:

(a) It systematizes variations and renders traits measurable as quantifiable data – after all, natural traits (e.g., height) vary along a dimension, so why should not psychological ones?

(b) The diversity contained in dimensions can always later be systematically and empirically converted into categories (e.g., personality 'types'), but the reverse is not the case – importantly, the cut-off for clinical categories is empirically based and not arrived at arbitrarily by committee consensus.

(c) There is no contradiction where quantitative extremes on the same dimension, as calculated through statistical cut-offs, may subsequently differ qualitatively – an example here is hoarding disorder where a dimension of accumulation at extremes may be motivated by distinct processes (e.g., hoarders for whom hoarding is a clinically significant problem tend to vary from non-hoarders in terms of other dimensions as attachment issues, organisational strategies and self-ambivalence; Frost & Hartl, 1996; Koszegi, O'Connor, & Brodryzlova, 2017).

(d) A dimensional approach allows portrayal of an individual as complex and multidimensional and some dimensions may be more important than others at different times and occasions – this is a fundamental point of Eysenck's work, because a small number of dimensions allows for many individual configurations. People have profiles and are not one-dimensional and profiles may better predict pathology than single components.

(e) The dimensional approach allows us systematically to go beyond individual symptoms and signs which in themselves may not reliably appear but form rather part of a pattern (Polman, O'Connor, & Huisman, 2011). Knowing this personal pattern may permit prediction of further less obvious symptoms. For example, knowing how a person scores on dimensions of Impulsivity, Extraversion and Neuroticism allows us to predict wide-ranging behaviours such as leisure activities, lifestyle habits and physiological reactions to stimulation (Eysenck, 1967).

(f) Putting psychopathology on a dimension allows aberrant behaviour to be identified on one end of a continuum with normal behaviour. This allows for the understanding of patient behaviour as a *progression* (O'Connor, 2016). It also somewhat normalizes the behaviour since

extreme anxiety, for example, can be related to a normal anxiety that everyone experiences – we are all somewhere along the dimension! (Abramowitz et al., 2014).

(g) Finally, a dimensional approach has a destigmatizing influence. Psychiatric patients do not come from another planet; their symptoms are cut from the same psychological cloth that the rest of us wear. We all exist on the same plane, but at different points with some people at the extremes. In addition, measuring symptoms dimensionally can sometimes indicate the normality of some symptoms, such as phobias, intrusions and even voice hearing, and this in itself can provide comfort (O'Connor, 2009; O'Connor, St-Pierre Delorme, Leclerc, Lavoie, & Blais, 2014).

There is something else of importance about the dimensional approach that has not been highlighted enough. Behavioural or psychological dimensions yield explanatory power greater than diagnostic category by treating the individual as a multidimensional being that cuts across diagnostic boundaries. This is seen in the case of neuroticism which, indeed, cuts across diagnostic boundaries and accounts for distress and adaptation more reliably than psychiatric classification (Hengartner, Tyrer, Ajdacic-Gross, Angst, & Rossler, 2017). Other related research confirms this general finding; for example, O'Connor et al. (2004) found that neuroticism better predicts withdrawal distress than psychiatric diagnoses. Eysenck's 1944 classic study was the first to say that this was the case, but it took many years to confirm, as it did in relation to his other theories (e.g., heritability is common in all psychological traits, including intelligence; Hagenaars et al., 2016).

An experimental approach to personality and clinical psychology

In his 1944 paper, Eysenck was at pains to offer suggestions as to the theoretical bases of the dimensions he thought he had isolated. He noted that the formation of a reflex to strong stimulus is a 'kind of sign of the "boldness" of the animal'. In relation to psychiatric disorder and following Pavlov's inspiring lead, Eysenck proposed that as people high on Neuroticism have a 'weak' nervous system, and their ability to form conditioned reflexes breaks down under conditions of strong stimulation and this predisposes them to a range of neurotic conditions, defined in terms of failures of adaptation. In relation to the Introversion–Extraversion dimension, Eysenck related this to the *balance* (as opposed to strength) of inhibitory and excitatory processes, which gave him further explanatory licence to relate both personality dimensions to mental illness – as the balance of nervous system weakness is in the direction of introversion, those most liable to neurotic breakdown are assumed to be neurotic introverts – in the opposite stable-extravert quadrant are found content and happy individuals.

As we can see, from this 1944 classic study came a flowering of new scientific ideas and explanatory models of personality. We have already seen something of the 1957 inhibition/excitation theory above – for further description, see

Corr (2016a). The 1967 theory extended this causal thinking in the direction of known neurophysiological systems. It postulated that variations along the Introversion–Extraversion dimension relate to variations in the sensitivity of an arousal system in the brainstem, known as the *Ascending Reticular Activating System* (ARAS). Activation of the ARAS has diffuse arousal effects on cortical areas of the brain, and higher cognition (thinking, reasoning, etc.). The ARAS can be likened to a volume dial, or sensory filter: the lower it is, the less arousal is sent to the higher brain areas and, thus, the lower a person's level of cortical (and cognitive) arousal.

According to this arousal theory, compared to extraverts, introverts have lower response thresholds of the ARAS (higher volume control) and, thus, more easily generate a higher level of cortical arousal. In consequence, they are easier to arouse and tend to be in a chronic state of high arousal throughout the day. In contrast, the ARAS of the extravert is sluggish (lower volume control) and it takes more stimulation to get them going to the same extent as the introvert. *For this reason*, introverts seek environments that do not over-stimulate them (therefore they are retiring and reserved in character); whereas extraverts behave in ways to increase their stimulation in order to reach an 'optimal' level of arousal defined in hedonic terms. In this way, introversion and extraversion themselves are reflections of behavioural strategies designed to modulate level of stimulation and, thus, level of arousal.

One demonstration of the greater arousability of introverts is seen in the lemon juice test, which attracts the attention of the media when they want a simple demonstration of Eysenck's personality theory (e.g., the BBC: www.bbc.co.uk/science/humanbody/mind/articles/personalityandindividuality/lemons.shtml). The test consists of four drops of lemon juice dripped on to the tongue and then the use of a dental swab to collect the resulting saliva – to establish a baseline, saliva is collected before the administration of the lemon drops. This beautifully simple experimental procedure leads to significantly more saliva generated in introverts than extraverts, and this happens even *before* the lemon drops are administrated, suggesting that placing the dental swab in the mouth is enough to stimulate the salivary glands. However, significantly more saliva is produced in introverts in response to the lemon drops as shown by the differences score in swab weight before and after lemon juice administration. Of interest here, the correlations, which are large in magnitude (~ -0.70) and statistically significant are with Introversion–Extraversion, not Neuroticism, suggesting that the Introversion–Extraversion dimension, and not the Neuroticism one, is the relevant personality dimension in relation to arousal.

In relation to his second dimension, Neuroticism, Eysenck relates this to *activation* of the limbic visceral system and emotional instability, although it must be said that he failed to elaborate this part of his theory to the same extent as Introversion–Extraversion and arousal (for further discussion of Eysenck's arousal/activation theory, see Chapter 7).

The arousal/activation theory has a high degree of relevance for clinical psychology, especially behavioural therapy. Eysenck assumed that, by virtue of their

personality, people who develop neurosis have a predisposition to condition more easily to all stimuli, including aversive ones. Hence, they are more likely to become fearful and anxious than people low on this predisposition. For this reason, people who suffer neurosis tend to be introverted (i.e., highly arousable and chronically aroused), and this is especially true if they are also highly emotionally driven by virtue of their higher level of neuroticism. In contrast, lowly aroused extraverts show a variety of 'hysterical' behaviours – in modern day parlance, externalizing disorders. They are said to be more difficult to condition (socialize to societal mores), and in an attempt to modulate their arousal to reach an optimal level, more prone to 'act out', take more arousing drugs (e.g., amphetamine), and engage in a host of behaviours that often get them into trouble with the law – whether by direct behaviour (sensation-seeking) or as an indirect consequence (e.g., criminal behaviour to fund their drug addiction).

CRITIQUE OF THE STUDY

As should come as no surprise when the work of such a 'controversial' psychologist is discussed, there have been criticisms of Eysenck's 1944 classic study, which set a pattern of acrimonious debate that attended his entire professional life for the next 50 years (Corr, 2016a, b, c) – yet, as we will see, this is another example of, when scrutinized closely, Eysenck's work stands up very well.

The perceived problems with this 1944 classic study were highlighted in Buchanan's (2010, p. 158) biography of Eysenck, in which he states:

> Other researchers published inconsistent results. The most notable of these was a 1973 study by another former colleague, Edgar Howarth.

Howarth reported finding a very different structure to the one contained in Eysenck's 1944 own data. Howarth's first factor seemed to be cognitive ability, and Extraversion was poorly defined in the whole analysis. This outcome seems to undermine the very foundations of Eysenck's entire work in the field of personality psychology! It is, therefore, important to consider this matter in some detail, especially as few people have inspected Howarth's paper, and even fewer (if any) have reanalysed the actual data to arrive at their own conclusions.

Howarth started by acknowledging the importance of Eysenck's early work: 'In this foundation study he evoked, for the first time, the concepts of "neuroticism" and "extraversion" which have since played such a prominent part in his system' (p. 81) – although, as we have already seen, these constructs were already established in the psychology/psychiatry literature. Howarth then presented 'unrotated' and 'rotated' factor solutions – these are technical terms concerning how best to 'picture' in geometric and mathematical terms how items load on factors. The major thing to know about Howarth's two-factor *unrotated* solution is just how well it replicates Eysenck's own first two factors. There are, indeed, differences in the factor loadings, but the general pattern bears out Eysenck's interpretation in

all essential respects. However, it is generally accepted that a *rotated* solution is best – factors are rotated in the first place to achieve psychological interpretability (e.g., a 'simple solution' in which items load on only one factor and are not confusingly spread over different factors).

In both Howarth's and Eysenck's analyses, factor one is defined by the following items: 'abnormality before illness', 'dependent', 'little energy', and in both analyses the highest loading is 'badly organized personality'. Both analyses indicate this factor is, most probably, Neuroticism. Howarth (p. 83) concluded: 'While the writer would prefer not to even attempt to interpret this unrotated factor there is an indication that this is a very broad kind of adjustment-emotionality factor.'

Concerning the second factor in the unrotated solution, both Howarth and Eysenck agree that this is a bipolar factor that contrasts anxiety/depression and hysteria. This outcome may be seen to support Eysenck labelling of this factor as Introversion–Extraversion (or for simplicity, Extraversion). However, Howarth (p. 83) preferred a different conclusion, saying: 'Thus our second factor is, possibly, a better candidate for "neuroticism" than the first. We would certainly not view this second factor as simply "hysteria–dysthymia" on the basis of only four variables among 39.' This is a fair point to make, but it is an *interpretation* of these data (no better or worse than Eysenck's alternate interpretation).

Concerning the third factor, which Eysenck identifies as Hypochondriasis, Howarth (p. 83) stated: 'Regarding the third factor, we find a similar grouping of salients [factor loadings] to that reported by Eysenck and have no quarrel with his interpretation.'

Turning to the two-factor *rotated* solution by Howarth, but not Eysenck, things are very different. Howarth used Principal Axis Factoring followed by Varimax rotation (the details are not of importance to the non-specialist aside from knowing that this procedure imposes statistical independence on the factors – i.e., they are not correlated). In Howarth's rotated solution, Factor 1 is defined by low intelligence, being unskilled, narrow interests and having little energy. Factor 2 seemed to Howarth to be an adjustment-emotionality factor reflecting a predisposition to either neurosis or psychosis – Howarth (p. 85) stated: 'The second factor cannot, in our opinion, be labelled "neuroticism"', although this interpretation would not be inconsistent with such a label.

Well, what about the hysteria–dysthymia factor (which forms the basis of Eysenck's later Extraversion)? Something similar to this is found in Factor 3, which contrasts 'obsessional' with 'hysteria'. Howarth (p. 85) noted: 'It would be unwise to name the factor "hysteria–dysthymia" solely on the basis of a restricted number of variables'. But an Eysenck-favourable interpretation is not inconsistent with the nature of this factor.

Therefore, what we seem to have is a rotated factor structure that lends itself to various interpretations, one of which is consistent with Eysenck's claim for his unrotated solution of two factors of maladjustment (Neuroticism) and dysthymia–hysteria (Introversion–Extraversion).

But, things did not stop there. Howarth went on to conduct another analysis based on an 'oblique' rotation – which allows factors to be correlated with one

another. Howarth reported finding 16 such 'primary' factors, and his oblique rotation extracted the first factor which seemed to resemble Neuroticism and the second factor hysteria–dysthymia (Extraversion–Introversion). Although Howarth chose not to apply these labels to these two factors, the first two factors of the three-factor second-order solution do not contradict Eysenck's original unrotated two-factor solution and interpretation.

To reconsider this whole debate, Adam Perkins and Philip Corr asked one of the leading factor analysts in personality psychology, Professor William Revelle of Northwestern University in the USA, to reanalyse Eysenck's 1944 dataset. This is what Revelle reported: the analysis showed 'when the first four factors are extracted, the first 3 agree with the Eysenck solution – but the fourth factor does not resemble Eysenck's at all.' This reanalysis also showed that there were some aspects of the data , such as their ordinal nature, that render certain forms of factor analysis unreliable – this probably accounts for the aberrant findings of Howarth which have received so much attention by those who would want to criticize Eysenck's 1944 classic study.

What all of the above draws to our attention is that there are often tricky technical issues that need to be considered when evaluating Eysenck's 1944 classic study. With the benefit of hindsight, no one would chose to rely upon the type of data presented to Eysenck in the early 1940s, and it really is not surprising that they lend themselves to very different interpretations. It is clear from this 1944 study that Eysenck was using the outcome of this statistical analysis to *inform* his theories; he was not using these data as the only means to arrive at a theory of the underlying factors of mental disorders. His 1944 data were a starting, not an end point. As the years rolled forward, Eysenck went on to confirm the existence of Introversion–Extraversion and Neuroticism in the normal population, and he spent the coming years refining their measurement and elucidating their biosocial natures. In recognition of their value, factors of Extraversion and Neuroticism are found in virtually all other descriptive measures of personality.

The fact that Eysenck wanted to develop a personality system that would be of practical use by psychiatrists and clinical psychologists has fared less well. Despite the many remarkable achievements during his lifetime (he died in 1997), Eysenck's personality questionnaires were never widely used by clinicians – they just seemed too distant from the patient's presenting symptoms. Whilst this was true, what they offered the research psychiatrist and clinical psychologist was a way of thinking, as well as measuring, the relationships between clinical conditions and broad dimensions of personality, the latter of which have considerable experimental evidence attached – this approach was more fully formed in the work of Jeffrey Gray and others who followed in his foot steps (see Chapter 7).

Despite the slow progress, there have been moves even within psychiatry to attempt to link human behaviour with psychopathology dimensionally and psychiatry is moving more towards dimensional assessment (Rosario-Campos et al., 2006). Normalization is now a common technique used in psychoeducation where, for example, normal curves of thoughts are shown to the patient to emphasize normality. Also, research of traits on large numbers has become feasible exactly because

concepts of dimensionality encourage the use of analogue samples to understand a problem (Abramowitz et al., 2014). However, the downside of the dimensional approach is in developing a dimension that is too abstract or too large and is not clinically precise enough. It may not relate satisfactorily to clinical significance.

So we have built on Eysenck in the refinement of personal constructs to make the constructs at the same time more clinically relevant but also more specific to the individual differences. One of the criticisms of Eysenck's personality theory was that the constructs such as extraversion, or arousability are simply too large to be relevant to specific clinical behaviour. For example, there are several activation systems of arousal and specific activation, such as: motor arousal, behavioural arousal, sensory arousal, which may often be discordant with each other. Does this mean we need to throw out the concept of general arousal? Absolutely not, since at a macro-level it still makes sense to describe a person along an aroused – not aroused dimension. Eysenck foresaw that many general notions may need operationalizing in specific ways as our knowledge becomes refined. The trick is to conserve both levels to predict both specific and general, as in recent attempts to characterize dimensions of motor arousability (O'Connor et al., 2015).

Eysenck's legacy from this 1944 paper lies perhaps not just in the applications of personality theory to clinical patients, but also in the refining of personal expressions and detecting subtle self-variables and measuring them and discovering new dimensions of clinically relevant behaviour which can be measured and linked to experimental constructs.

CONCLUSIONS

Already in 1944, Eysenck was speculating how his findings may translate into brain mechanisms and genetics. He clearly foresaw the necessity of cross-validation between psychometric and experimental methods. It may be time to recast Eysenck as a unifier in several respects. Apart from his concern to combine the two psychologies – normative (between individuals) and ipsative (within individual) – he was open to embracing a wide range of potential concepts if they could be operationalized and tested and he was at pains in his 1944 paper to integrate previous theories from a variety of theoretical sources.

It is appropriate to include the summary of Eysenck's work from one of his most severe critics (Lykken, 1982):

> He was perhaps the first experimental psychologist to realize the importance of individual differences, the first differential psychologist to exploit the causal theories and measurement techniques of the experimentalists, the first (only?) major psychologist to bridge the gulf between Cronbach's two disciplines of scientific psychology.

We owe it to Eysenck for enabling a whole new scientific field, personality neuroscience, to be developed which is bound to continue to make profound insights into individual variation seen in the general population and clinic – there is now

even a journal, *Personality Neuroscience* (published by Cambridge University Press; founded and edited by one of the authors of this chapter), which in many ways is the culmination of Eysenck's 1944 classic study. Of considerable significance, Eysenck's idea that general dimensions of personality may determine vulnerability to clinical disorder is gaining scientific traction – this is seen in the remarkable finding that the general personality factor of Neuroticism cuts across a very broad range of psychiatric conditions (Hengartner et al., 2017), and now that we are gaining insight into the molecular genetics of Neuroticism (Luciano et al., 2018). Exciting times lie ahead for linking personality and psychopathology: it is what Eysenck promised us way back in 1944.

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