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Angus H. Thompson

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ORIGINAL PAPER

Measures of mental health and addictions conditions show a U-shaped relationship with self-rated worker performance

Angus H. Thompson[1]

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Abstract

Background Reports of a meaningful relationship between mental health-related conditions and work productivity measures are relatively common. These, however, are frequently examined for their linearity while ignoring untapped, and potentially rich, non-linear associations.

Methods Following a serendipitous finding of a curvilinear relationship between workplace presenteeism (lowered productivity while at work) and depression, an investigation was undertaken of the association between worklife prevalence measures of presenteeism (measured by the W.H.O. Health & Work Performance Questionnaire) and lifetime prevalence of twelve psychosocial vulnerabilities, encompassing mental health, mental health-related, and addictive conditions. Linear and quadratic (U-shaped) functions were calculated across the "relative" presenteeism measure (self vs. other workers) for each of the 12 conditions.

Results A visual analysis revealed a U-shaped graphic function in all conditions, and excepting anxiety all were statistically significant. In general, increases beyond the lowest ("poorest") level of self-reported comparative productivity were associated with increases in psychosocial stability, but only as far as deemed equality. Beyond that, increases in self-confidence resulted in a reversal, thus returning to a higher level of vulnerability for the condition in question. A cursory scan of five relevant journals indicated that non-linear analyses were often possible, but rarely carried out.

Conclusions This has informative value for our conceptualization of overconfidence, and it begs the question of whether an over-reliance on linear measures has caused us to overlook important curvilinear human relationships. The inclusion of analyses of non-linear functions is suggested as a matter of course for future studies.

Keywords Mental health · Presenteeism · Overconfidence · Addiction · Non-linear

Introduction

Presenteeism (lost productivity while at work) has often been found in association with mood disorders and other mental health conditions [1–4]. The relationship, however, is often complicated by variations in the influence of self-perception factors such as self-enhancement or self-depreciation in comparison to others [5, 6]. These findings have traditionally involved linear associations, but here I report a serendipitous finding of a U-shaped function describing the relationship between self-rated work performance and a number of psychosocial conditions.

✉ Angus H. Thompson
gthompson@ihe.ca

[1] Institute of Health Economics, 1200, 10405 Jasper Avenue, Edmonton, AB T5J 3N4, Canada

Background

Findings depicting a linear association between depression, for example, and presenteeism are not merely abundant, they are often quite profound. To this end, Kessler and colleagues [7] studied the relationship between productivity and a broad variety of conditions (e.g., heart disease, cancer, diabetes, sleep, arthritis, obesity, and many more, including depression). They found that when depression was controlled for, only migraine showed any reliable association with their measures of on-the-job output. This conclusion reinforced earlier findings that emphasized the strength and durability of the linear relationship between depression and work productivity [2, 8–10]. Furthermore, Sanderson and Andrews found that anxiety, as well as depression, was strongly implicated in productivity deficits – particularly when presenteeism, rather than absenteeism, was involved [11]. In fact,

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individuals with comorbid mood disorders were 5.6 times more likely to show "interference" with their work than those not exhibiting a disorder [12].

On the presenteeism measurement side of the ledger, the mainstay of epidemiological examinations of productivity has been one or another among a selection of self-report presenteeism tests. A caution; this class of instruments has recently been criticized for a lack of evidence in support of their validity, usually with the caveat that the proper validity studies have simply not been done [13–15]. These tests are thought to be potentially problematic because of poor specification of expected outputs [13] and issues of method variance [16, 17].

Presenteeism responses, although they are often recorded on interval or ratio scales that are amenable to non-linear forms of analysis, are usually analyzed by procedures that extract only a linear component (e.g., correlation, regression). This depiction of the relationship is not entirely justified. Presenteeism, as a measure of performance, is unlikely to operate in an exclusively linear fashion. For example, a variety of performance measures have proven to be subject to the Yerkes-Dodson principle [18], where an inverted-U function has been found to describe the association between such activity and measures that denote arousal, mental disorder, or stress (note that the term "U-shaped function" which is used below, is made equivalent to its "inverted-U" form by simply reversing the valence of the dependent variable). Illustratively, this form of association has been found between depression and BMI [19] as well as between depression and obesity, where both overweight and thin people show an elevated likelihood of depression [20]. Notably, depression symptoms follow a U-shaped function across the life span [21] and those in the lowest and highest quartiles of the job strain ratio [22] were more likely to have developed major depressive disorder over a 1-year course [23].

Overall, these findings suggest that presenteeism is similarly prone to non-linearity in its relationships, a likelihood that formed the impetus for this investigation. The broad array of human variables that are so affected suggests that several psychosocial factors assessed in the survey used to form the database used here profitably be included in the present analysis.

Methods

Participants

The data for this study were drawn from responses to a telephone survey of mental health and addictive behaviours in the workforce in Alberta, Canada [24]. The respondents were 2,817 individuals ranging in age from 18 to 80 years (mean = 45.4 years, SD = 11.8) who were in the workforce at some time during the 12 months preceding data collection. Of these, 64.1% were employed full-time, 18.2% were part-time workers, 10.3% were self-employed, and the remaining 7.3% were not working at the time due to either paid maternity leave, temporary layoff, workers compensation, or job loss. The proportion of females was 60.2%. The majority of respondents (74.3%) were married or living together as married, 8.3% were divorced, 2.2% were separated, 2.0% were widowed, and 12.9% had never been married. Education-level was grouped into three categories; high school or less (29%), technical or trade school (33%), and university graduation (38%). Average income among Albertans was the highest in Canada at the time of the survey. In 2009 dollars CAD, household income of 21% of the survey respondents was categorized at less than $50,000, below $100,000 for the next 37%, and $100,000+ for the top 42%. Finally, a summary distribution of the respondents was, according to an aggregation of Canada's National Occupational Classification system; Manager/Professional 41%, Services (catering, accommodation personal services, etc.) 18%, Business proprietor 10%, Clerical/Office worker 10%, Sales 6%, Construction worker 5%, with the remaining 10% comprising several other occupations. More details on this survey can be found elsewhere [24, 25].

Survey data

Demographics and information on mental illness diagnoses, mental health-related conditions, and addictive behaviours were gleaned from the above-noted workforce survey [24]. Specifically, depression symptoms were assessed using items from the Mini International Neuropsychiatric Interview (MINI Plus version 5.0.0) [26]. A lifetime diagnosis of major depressive episode (MDE) was assigned to individuals when (a) one or both core symptoms were reported to be present, and (b) three or more of the seven secondary symptoms were also endorsed. Items pertaining to the remaining mental health and addictive behaviour conditions are quite straight forward (see Table 1).

Relative presenteeism was calculated using two items from the W.H.O. Health & Work Performance Questionnaire (HPQ) [32, 33]. One of these questions required the respondent to rate his or her own productivity over the past week on an 11-point (0–10) scale (see Table 2), and the second to similarly rate the usual performance of most workers in a job comparable to that of the respondent. Relative presenteeism scores were obtained by calculating the self- to other-ratio for each condition. Due to concern about "extreme" (outlier) scores, the HPQ authors have suggested that scores above 2.0 should be recorded as 2.0 and all scores below 0.25 should be recorded as 0.25 [34]. Both suggestions were adopted here.

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Table 1 Mental health and addictive behaviour measures

				Source
Mental health (mood)				
Core depression	Depressed/down and/or anhedonia for 2 weeks	Yes/no		MINI[a]
Major depression	Core Depression plus three symptoms	Yes/no		MINI[a]
Phobia	Avoidance due to unreasonable fear of a situation/thing: social, simple or agoraphobia	Yes/no		NPHS[b]
Anxiety	Three or more spells within 3 weeks of anxiety when most would be unafraid	Yes/no		NPHS[b]
Mental health related				
Suicidality	One or more of death thoughts, death wish, ideation, or attempt is exhibited	Yes/no		NPHS[b]
Antisocial personality	3+ of irresponsibility, illegal activity, fighting, lying, endangering others, remorselessness	Yes/no		MINI[a]
Hopelessness	Has there ever been a period of time when you felt that life was hopeless?	Yes/no		NPHS[b]
Work Stress	How stressful do you consider your job?	Nil-low/extreme		AADAC[c]
Addictive behaviours				
Smoking	Smoking within the past month, irrespective of the number of cigarettes consumed		Yes/no	AADAC[c]
Alcohol use disorder	High vs. low risk ("High" subsumes original categories high and very high)		Low/hi	AUDIT[d]
Drug abuse	High vs. low risk ("High" subsumes original categories high and moderate)		Low/hi	DAST[e]
Gambling	High vs. low risk ("High" subsumes original categories high and moderate)		Low/hi	CPGI[f]

[a]The Mini-International Neuropsychiatric Interview [26]

[b]National Population Health Survey [27]

[c]Alberta Alcohol & Drug Abuse Commission (Price Waterhouse) [28]

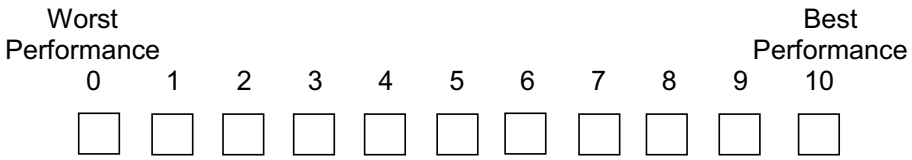
[d]Alcohol Use Disorders Identification Test [29]

[e]Drug Abuse Screening Test [30]

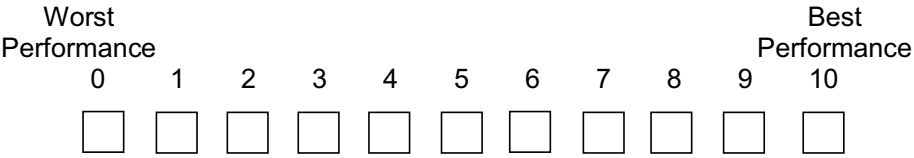
[f]Canadian Problem Gambling Index [31]

Table 2 W.H.O. health and work performance questionnaire

On a scale from 0 to 10 where 0 is the worst job performance anyone could have at your job and 10 is the performance of a top worker, how would you rate the usual performance of most workers in a job similar to yours?



Using the same 0 to 10 scale, how would you rate your overall job performance on the days you worked during the past week (7 days)?



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There is an often unaddressed factor that clouds the interpretation of test results that has additional importance here. This is, the "better than average effect", which is the tendency of individuals to overestimate their own performance [35, 36]. This phenomenon can be expected to come into play in an ego-involved assessment situation such as the collection of work self-ratings [37]. That is, when asked to compare oneself to others on a variety of performance measures, 60–70% of respondents characteristically place themselves above "average" which, of course, is a category that has room for only some value below 50%, depending on the extent of the range deemed to be "equal". This has implications for potential bias here, since it indicates that the levels of the independent variable should be created with consideration of the likely skew "to the right", thus suggesting the need for additional measurement points when such non-linear relationships are likely.

Procedure

The database used here was formed in a prior investigation [24, 25], where the survey questionnaire was administered via telephone by trained interviewers. Administration of the survey was spread over a 13-week period [24]. Furthermore, as a consequence of the results produced (reported below), it was decided to pursue a brief scan of a sample of articles from the 2019 contents of each of five prominent journals (*Social Psychiatry and Psychiatric Epidemiology*, the *Journal of Abnormal Psychology*, *Depression & Anxiety, World Psychiatry, and the Journal of Occupational and Environmental Medicine*) to obtain a cursory view of the appearance of linear analyses when a non-linear analysis would have been feasible. Research articles from single 2019 issues of the first three journals plus an assortment of 2019 articles from the latter two were selected for review. These journals publish in key areas within mental health, including psychiatric epidemiology, psychopathology research, mood disorders with a clinical/research slant, International mental health issues, and workplace health.

Analyses

Although some forms of depression have been well measured by questionnaires that produce continuous scores, clinical diagnoses like major depression, as indicated above, are frequently viewed and reported as two-category variables (i.e., diagnosis vs. no diagnosis), thus leaving the choice for a multi-level independent variable to rest with a suitable presenteeism instrument. The design for a study of a U-shaped (quadratic) function, then, must include the use of a measure of presenteeism that has at least three levels. Here, however, the expected skew due to the influence of the above-noted "better than average effect", plus the desirability of symmetry surrounding the central "Equal" value, points to a five-level solution. That is, one level for self-other equivalence, with two categories denoting productivity above that of the average worker to allow an extra level of precision in the "better than" range. Two levels below were deemed necessary to accommodate symmetry across five levels, in spite of the expectation that group size would not be balanced.

This study, then, involved an examination of the relationship between relative presenteeism, calculated from HPQ responses [32, 33] and the 12 psychosocial conditions listed in Table 2 in a sample of adults in the Alberta, Canada workforce. The underlying skew, of course, militates against the formation of groups of equal size. However, the key analyses will rely on comparisons of proportions, thus largely obviating that difficulty. Basic statistical analyses were conducted with SPSS 14.0 for Windows. Mantel's procedure for the detection of progressive increases across groups was used to test for linear trends in the lifetime prevalence of each of the 12 conditions across the five levels of relative presenteeism [38]. The Mantel procedure was adapted with the use of orthogonal polynomials to test for quadratic functions as well as for the typical linear functions. This distribution-free statistic is an extension of the standard 2×2 Chi-square application to allow for several levels of one of the variables. The orthogonal polynomial coefficients are applied to weight the similarly ordered multi-level variable to create the expected distribution against which the observed scores are compared. Significance levels are tested with one degree of freedom for the linear trend and one for the quadratic. Calculations were made with the use of an online statistical analysis site [39]. Standard linear and quadratic 5-level orthogonal polynomials were applied. Respectively, $-2, -1, 0, 1, 2$ for linear contrasts, and $2, -1, -2, -1, 2$ for the quadratic versions.

The Journal Scan comprised tallies pertinent to three questions; (1) was a linear analysis conducted (including binary response choices like "Yes/No"), (2) was a non-linear analysis possible?, and (3) was any sort of non-linear trend analysis conducted?

Results

The overall response rate to the survey was 42.3% of those contacted, but it should be noted that it improved throughout the course of data collection, ranging from 28.8% and 27.0% for the first 2 weeks to 72.5% and 72.8% for weeks 12 and 13.

Table 3 shows the parameters of the self vs. other groupings. Note that a respondent's assertion that they deemed themselves to be the equal of their co-workers naturally produced a ratio score of one. That rating alone defined the

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Table 3 HPQ self-ratings in relation to other workers

	Ratings ratio range	*n*	
Much poorer	0.25–0.86	98	4.2%
Poorer	0.87–0.99	109	4.7%
Equal	1 exactly	913	39.2%
Better	1.01–1.49	937	40.3%
Much better	1.50+	270	11.6%
Total		2327	100%

central group comprising 39.2% of the respondents. The egalité ended there, however, since 51.9% reported superiority over others, while only 8.9% asserted that they were less productive than their colleagues, a likely consequence of the "better than" effect [35, 36]. The scores with a self to other ratio below 1.0 were divided into two approximately equal groups to optimize power among this smaller segment of the overall sample. At about 100 persons each, power was more than adequate.

Note this configuration is unbalanced in terms of group size, but the distribution of the groups forms a balance within the continuum of relative presenteeism.

Main analyses

Figure 1 shows the relative presenteeism curves for each of the twelve conditions under consideration. Note that in contrast to much of the literature cited, the graphic depiction of the U-function is not inverted. This is because here, the dependent measure (depression prevalence, for example) is negatively valenced (i.e., larger scores represent psychosocial vulnerability, rather than adaptability).

A review of the trend lines of the 12 graphs in Fig. 1 immediately shows that we are not able to use a linear function to adequately describe the relationship between rises in self-confidence and linked levels of personal difficulties. Rather, taking all into consideration, the best overall description proved to be a U-shaped function with its lowest (and most optimistic) point signifying the perception that one's own performance is equal to that of others doing similar work. Thus, groups both above and below perceived equality seemed to be showing higher levels of the psychosocial vulnerability in question. Conditions providing an exception were (1) Extreme stress, where "Equal" ranked second, behind those who felt that they were somewhat poorer than their peers and (2) anxiety that did not display statistical significance ($X^2 = 1.40$, $df = 1$, $p = 0.24$).

Table 4 shows the statistical testing that corresponds with the trends depicted in Fig. 1. The analyses provide strong support for the graphic observations. Mantel's procedure, when adapted for use in the assessment of quadratic functions, showed that 10 of the 12 (i.e., all but anxiety and stress) showed a statistically significant U-shaped function across the relative presenteeism range. However, as noted earlier, Stress visually displayed a U-shaped curve that was shifted one position "to the left", and all 12 showed, nominally, that the "poorest" members (and 11 of the 12 judged to be "poorer") were more likely to display personal vulnerabilities than those who deemed themselves to be equal.

Only two conditions showed a significant linear trend (smoking and problem gambling), indicating, for these conditions, that those who placed themselves in the "Best" level of relative productivity were also most likely to be vulnerable in terms of psychosocial difficulties, irrespective of the U-shaped function. However, a linear trend along the upslope of the curve (i.e., comprising "Equal" to "Best") was evident in nearly all, with those whose self-ratings placed themselves in the "Best" category to be nominally most likely to show personal vulnerability in 11 of the 12 categories (excepting anxiety), and statistical significance in 10 of 12 (hence excluding extreme stress as well as anxiety).

Journal scan

The preponderance of conditions showing a U-shaped vulnerability association with self-confidence begs the question of whether this might signify inadequate attention to non-linear issues in the literature. As this has not been reported to my knowledge, the results of the Journal Scan can be taken as preliminary evidence that it is an issue for important future research. The review of year 2019 research articles from each of the five periodicals produced 39 papers. All of these articles conducted linear analyses, but in spite of the finding that curvilinear trend analyses were feasible in 35 of the 39, only one included anything approaching this sort of treatment of a potential non-linear trend.

A note on depression

Core Depression (2 weeks of depression/flat mood and/or anhedonia) showed a profile that was nearly identical to MDE. This similarity suggests that the requirement for the inclusion of the three secondary symptoms required for a diagnosis of MDE made little difference. None of the seven candidate secondary symptoms showed a statistically significant relationship with relative presenteeism. This serves as suggestive evidence that investigations involving DSM-defined major depression would benefit from studying its two components, core depression and secondary depression symptoms, separately, rather than creating a confound by combining their apparently different influences into one variable [40].

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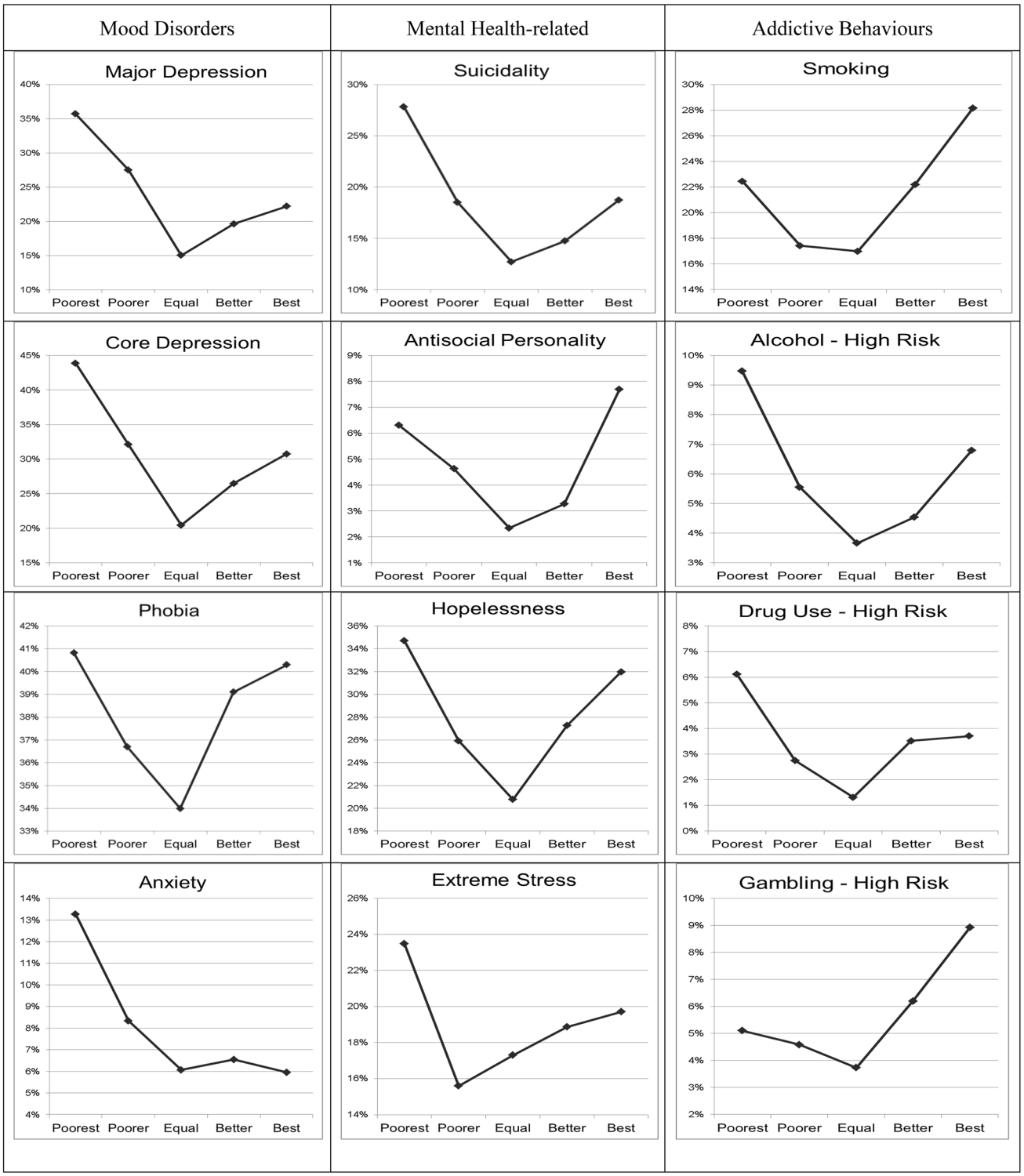

Fig. 1 Associations between relative presenteeism and mental health and addictive conditions

Discussion

It is apparent that relative productivity, as measured by the HPQ [32, 33], shows a U-shaped relationship with the majority of the 12 conditions under review (i.e., excluding anxiety which is strictly linear, and debatably excluding extreme stress which shows an offset U-function). Thus, non-linear relationships are pervasive across this version of

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Table 4 Quadratic and linear functions for contrasts delineating the nature of the association between presenteeism and the prevalence of each health condition

	Quadratic			Linear		
	U-function	X^2	p*	Slope	X^2	p*
Mental health (mood)						
Core depression	0.498	25.29	**0.0001**	−0.319	0.14	0.713
MDE	0.386	18.81	**0.0001**	−0.349	1.46	0.226
Phobia (Ag/Soc/Sim)	0.184	4.28	**0.039**	0.014	1.73	0.188
Anxiety	0.114	1.40	0.237	−0.164	3.22	0.073
Mental health related						
Suicidality	0.344	14.37	**0.0001**	−0.220	0.66	0.417
Antisocial personality	0.154	18.33	**0.0001**	0.014	2.20	0.138
Hopelessness	0.386	18.68	**0.0001**	−0.041	2.89	0.089
Extreme stress	0.173	2.00	0.157	−0.043	0.07	0.786
Addictive behaviours						
Smoking	0.276	14.33	**0.0002**	0.162	9.63	**0.002**
Alcohol high risk	0.151	8.46	**0.004**	−0.064	0.00	0.959
Drugs high risk	0.107	8.40	**0.004**	−0.041	0.65	0.422
Problem gambling	0.098	8.46	**0.004**	0.092	7.71	**0.005**

*p values < 0.05 are in bold typeface

self-confidence within, at least, the particular selection of inter-related social, mental and addictive conditions examined here. Two noteworthy postulates can be drawn from these findings. One to do with the meaning of the U-shaped trajectory of vulnerability across self-confidence levels, and the second with the methodological implications of assuming relationships are linear when they may not be.

Possible factors underlying the U-function

It is tempting to liken the U-shaped function, as it has played out here, with factors that may underlie the Yerkes and Dodson law [18]. It is very logical to conceive of some form of biological activation that begins at a low level (accompanied by behavioural lethargy) that, in reaction to fuel or fire, increases in intensity that, in turn, produce concomitant performance improvements until such performance reverses and begins an orderly decline, while arousal continues to increase. Presumably the higher levels of arousal, instead of energizing behaviour, now interfere with it as the organism in question shows a rising state of over-activation. Eysenck's refinement of the Yerkes-Dodson conceptualization posited that "arousal" was embodied in cortical excitation, delivered via brain structures such as the ascending reticular activating system, and that the level of excitation corresponded to the human personality dimension of introversion–extraversion [41]. Indeed, a number of studies have shown that extraverts have a lower resting level of cortical arousal than introverts. Theoretically, then, the former tend to seek stimulation, while the latter tend to avoid it, thus resulting in separate inverted-U distributions—positioned "left" and "right", respectively [42, 43]. Tops and colleagues have theorized that an important cause of behaviour decrements under high arousal lies with the notion of protective inhibition [44]. That is, such are due to a suppression of arousal by a central nervous system mechanism to protect against a stimulation overload as suggested earlier by Pavlov [45]. Experiments involved the presentation of stimuli of increasing in strength (e.g., sound or pain). The findings showed initial increases in physiological arousal with each increase in stimulus intensity. Consistently, however, the trend was reversed at some point—with each subsequent increase in stimulus intensity now accompanied by a decrease in physiological arousal. At extreme levels, the arousal system will shut down. Note that this interpretation posits arousal as the consequence of a stressor, while the aforementioned notions discuss arousal as a cause of performance variances; In other words, Tops et al. treat arousal as a dependent, rather than independent, variable [44].

In addition to these studies providing the above-noted interpretations vis a vis U-shaped functions, there are a number of investigations that, more specifically, have shown that moderate levels of arousal can aid performance improvements such as learning [46], task performance, and memory [47], while others have indicated that higher levels produce the expected downslope in performance [18] as the supposed consequence of cognitive interference [12]. Nonetheless, it should be noted that findings within the Yerkes-Dodson paradigm are generally based on changes within individual subjects, while the findings here involve differences between groups of individuals (i.e., respectively, within-subject vs. between-subject designs), thus possibly introducing susceptibility to the "ecological fallacy" of incorrectly attributing the latter to the same factors presumed to be involved in the

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former [48, 49]. This does not necessarily mean that bias is present, but that the risk of misinterpretation is elevated. In any case, the question is also raised by another conundrum; it is not clear how a continuum of arousal would explain the set of U-shaped functions reported here, nor is it clear that presenteeism represents an arousal-related gradient.

There are other potential explanations that convey some plausibility. A strong candidate lies in the role of the personal attribute, optimism. Evidence of the influence of this characteristic is its relationship with better health (both mental and physical), school and sports performance and work productivity [50]. Like arousal, optimism can serve to illuminate the rise in self-confidence in one's productivity, but it is an upgraded conceptualization of it by Kahneman that, at least here, might explain why further increases in positive self-ratings become associated with an upturn in psychosocial vulnerability, in general [51]. In agreement with Seligman [50], Kahneman views optimism as generally beneficial, but he also describes it as a catalyst for judgement errors that call into question the validity of self-ratings of this kind. He notes that humans' have a natural tendency toward an "optimistic bias" which comprises (1) a planning fallacy, a default to a best-case scenario stance that rarely materializes, (2) a view of the World as benign, (3) over-estimations of our own attributes, (4) misjudged achievability of our goals, and (5) exaggeration of our ability to forecast the future. It is worth mentioning the so-called "Dunning-Kruger Effect" here [52, 53]. It postulates, with good evidence, that those who express an extremely strong and unambiguous view about a particular topic (i.e., without an "it depends" disclaimer), tend to know the least about it. This is not out of line with Kahneman's view, but emphasizes the point that high confidence is likely to denote illusory self-ratings.

Grant and Schwartz [54] have addressed optimism within the rubric of Positive Psychology [55], which posits six personal "virtues": (1) wisdom and knowledge, (2) courage, (3) humanity and love, (4) justice, (5) temperance, and (6) transcendence [56]. They found that personal strengths in the first four attributes were accompanied by negative effects such as the underestimation of risks, unpreparedness and complacency due to overconfidence.

A comprehensive literature on a significant leadership attribute, charisma, has shown a strong relationship with self-confidence, with particular importance accorded to overconfidence [57–59]. Strong self-confidence allows charismatic leaders to appear credible and effective [60], although such may be a mask for selfishness, excessive pride, or narcissism among the very charismatic [59, 61–63].

Taking these cognitive explanations together, it suggests that two forces may be in play in the determination of the first (downslope) and second (upslope) segments of the U-shaped function. For example, it appears that this may be the case for differences in charisma, where leaders low on this attribute lack strategic behaviour, while highly charismatic leaders are deficient on operational behaviour [64].

Methodological consequences

Methodologically speaking, some number of wrong conclusions may have arisen due to an over-reliance on linear analytic models. The analysis here provided a clear example; it detected only two conditions showing a linear trend. If potential non-linear trends had not been examined, the strong quadratic influence would have been missed. Moreover, this and other linear-based operational definitions (e.g., groupings based on productivity-rank, binary splits into productive and underproductive self-perceptions, or analyses of extreme high vs. low productivity scores that avoid considering the less definitive "grey" area between) would have produced solutions that could not have adequately described most of the trends depicted in Fig. 1. To the extent that linear analyses are used without recourse to curvilinear effects, substantial portions of the research literature have possibly been reporting incorrect interpretations. This matter can likely be addressed with some relatively simple actions. The review process of relevant research journals could be altered to include a screening of submitted articles for multi-level variables that are amenable to curvilinear interpretations, managers of statistical analysis packages and online calculators can be encouraged to produce, and highlight, basic curvilinear descriptors when feasible, and educational components on mathematical curve-fitting and description could be developed and added to student curricula and distributed as continuing education supplements for current researchers.

Many of the above-mentioned early discussions on the nature of the underpinnings of the inverted-U function have implicated brain structures and function, but it is safe to say that they have been superseded by more recent renditions that have been able to incorporate the contemporary knowledge assembled by the mushrooming growth of neuroscientific findings. Leading among them is Sapolsky who, in addition to his identification of relevant brain function components, points to the "unifying clarity" that has resulted from the knowledge that the effects of stress on the brain form an inverted-U function that follows increases in stressor severity [65].

However, tantalizing the above positions, further discussion of the relative importance and contribution of these views is beyond the possibilities of this investigation. Thus, the question remains whether the relative presenteeism dimension under study here can be taken as a proxy for stress, or does it reflect some other force that coincidentally or indirectly, behaves like a stressor. To this end, Sapolsky has suggested that the topic of individual differences in the perception of stress (presumably including psychosocially-related distress) and the level of vulnerability to stressors,

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is a highly important topic in the field and the inverted-U function represents the most important concept in the field to aid in its understanding [65]. Presumably, the data here would retain some agency in this regard, regardless of its relationship with arousal.

Conclusions

Increases in the level of worker self-reported productivity are associated with variations in personal mental stability that rise at first, level off at about the mid-point of confidence in one's own productivity and then decrease. Thus, both worker self-depreciation and overconfidence are associated with poorer status on a number of mental health-related conditions. The inclusion of non-linear analyses is suggested as a matter of course for future studies when not ruled out by prior research or measurement restrictions.

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Availability of data and material The original database and the questionnaire have been provided to researchers and policy makers upon request.

Compliance with ethical standards

Conflict of interest The corresponding author states that there is no conflict of interest associated with this paper.

Ethics approval The study that produced the database in use here was approved by the Health Research Ethics Board of the Faculty of Medicine and Dentistry, University of Alberta.

Consent to participate In the study that produced the database in use here, respondents were interviewed by telephone (random dialing). It was explained that taking the survey is a personal choice, that names will not be taken, that information will be kept confidential and anonymous, that any question can be skipped- or the interview can be stopped at any time without negative consequences, and that the data collected will be stored in a locked site at the Institute of Health Economics and kept for at least 5 years. Furthermore, respondents were offered contact information for (1) mental health services (2) the project director, and (3) Health Research Ethics Board.

No prior publication This work has not been published before (neither in English nor in any other language) and that it is not under consideration for publication elsewhere**.**

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