Title: Development of a new scale to measure ambiguity tolerance in veterinary students.

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Abstract (max 250 words)

The ability to cope with ambiguity and feelings of uncertainty is an essential element of professional practice. Research with physicians has identified that intolerance of ambiguity or uncertainty is linked to stress [1,2] and some authors have hypothesised that there could be an association between intolerance of ambiguity and burnout (e.g. Cooke et al 2013[3]). We describe the adaptation of the TAMSAD (Tolerance of Ambiguity in Medical Students and Doctors) scale [4] for use with veterinary students. Exploratory factor analysis supports a unidimensional structure for the Ambiguity tolerance construct. Although internal reliability of the 29 item TAMSAD scale is reasonable (α = 0.50), an alternative 27 item scale (drawn from the original 41 items used to develop TAMSAD) shows higher internal reliability for veterinary students (α = 0.67). We conclude that there is good evidence to support the validity of this latter TAVS (Tolerance of Ambiguity in Veterinary students) scale to study ambiguity tolerance in veterinary students.

Key words

ambiguity tolerance, uncertainty tolerance, veterinary students

Introduction

The ability to cope with ambiguity and feelings of uncertainty is an essential element of professional practice. Health professionals may encounter uncertainty resulting from complex cases, indeterminate outcomes and ambiguous or missing data [5]. Veterinary competency frameworks acknowledge this, referring to the importance of coping with uncertainty due to incomplete

information or rapidly changing environments [6]. Experiences of uncertainty have not been compared between health professions and it is unclear whether veterinary professionals encounter ambiguous situations more frequently than their medical colleagues. Given that the clinical evidence base in the veterinary field is frequently not as well established, [7] and veterinary surgeons may work in mixed practice as well as primary care roles [8] where resource limitations and co-morbidity can produce complex and challenging caseloads [9] , it is possible that many veterinary practitioners may experience greater uncertainty in their day to day practice than those in other professions.

Defining tolerance of ambiguity

We adopt the definition of ambiguity used by Hancock [4] who defines ambiguity as: "vagueness and uncertainty of meaning"[10] . This definition positions ambiguity as the stimulus; and defines uncertainty as the response to an ambiguous situation [11]. Within this framework, ambiguity and uncertainty are not synonymous, although they are closely related.

The term tolerance of ambiguity (ToA) describes how individuals or groups identify and deal with ambiguous information when novel, complex and conflicting evidence is presented. [12]. Typically those with poor tolerance of ambiguity have a tendency to perceive ambiguous situations as a source of threat [13] A related concept is that of uncertainty tolerance which describes a cognitive bias that affects how a person perceives, interprets, and responds to feelings of uncertainty [14]. Although there is disagreement about the extent to which these two constructs can be compared; most authors recognise the close links between the two[5,15].

Ambiguity tolerance and patient care

Research in physicians has linked poor ambiguity tolerance to a number of factors influencing patient care[16]. Examples include increased ordering of tests[17], increased patient charges [18], a tendency to engage in defensive practice[17], worse attitudes towards underserved populations[19] and experience of discomfort in the context of death and grief [20]. ToA has also been linked to career aspirations, including medical speciality choice [21].

Ambiguity tolerance and wellbeing

Relationships between mental health, wellbeing and ambiguity tolerance have been proposed in a number of study populations including primary care physicians [22], general practice registrars [3], university students[23] and emergency physicians [1]. Individuals with low tolerance of uncertainty are reported to have increased risk of developing anxiety disorders, stress and burnout [1,3,24] and ambiguity intolerance is considered to serve as a vulnerability factor both for feelings of hopelessness and for depression[25]. In contrast, high tolerance of ambiguity is correlated with life satisfaction; and individuals with high ToA are less likely to report worry and perfectionism[23].

There has been limited development of a theoretical framework to explain links between ToA and mental health and wellbeing. One study in GP registrars [3] suggests that the concept of resilience may provide a link between mental wellbeing and ambiguity tolerance. Resilience in this context is defined as the process by which positive attitudes and effective strategies are employed to cope with difficulties[26]. Although the GP registrars with high tolerance of uncertainty were found to have greater resilience [3], the theoretical basis for this link is unclear. An alternative, but related

theoretical framework is the biophysical model of challenge and threat[27] which is a development of the concept of psychological toughness. This model proposes that individuals may perceive a given situation as either challenging or threatening. An ambiguous situation is more likely to be appraised as threatening by an individual with low ambiguity tolerance, and this threat appraisal may produce a different physiological response than a challenge appraisal. [23]. Although this model is supported by data from university students[23], there is currently limited evidence to support its use beyond this context.

Ambiguity tolerance in training: state or trait?

There is ongoing debate on the extent to which ToA should be considered a stable personality trait or whether it is in fact a malleable attitude [16,28–31]. This is important because there is debate over whether ToA should be one of the selection criteria to the health professions, or whether educators should instead focus on training and support for students to cope with ambiguous situations and feelings of uncertainty. A number of studies have tried to understand whether ToA can change during the course of medical training. Hancock and others [4] found that postgraduate doctors had higher tolerance of ambiguity than 1st, 2nd, 4th year medical students. Han[32]describes a significant decrease in tolerance of uncertainty over the course of undergraduate medical education (between years 1 & 4), whereas other studies[28,33] did not find any change in tolerance of ambiguity over the course of medical training. These apparently contradictory findings may partly result from differences in measurement scales and use of cross sectional study designs.

Ambiguity tolerance and veterinary students

Despite a number of studies looking at ambiguity tolerance and related constructs in other health professions, the ability of veterinary students to tolerate ambiguity or uncertainty has not been studied. Given that mental health and well-being of veterinary students and practitioners is of increasing concern within the profession, we argue that it is important to investigate the nature of the construct in veterinary populations and consider the influence which attitudes to ambiguity and uncertainty may have on professional development. Although models of veterinary mental health recognise the possible influence of personality [34]; the significance of ToA has not been considered in this context.

Aims of the current study

The aims of this study are to develop and validate an instrument suitable to evaluate ambiguity tolerance in the veterinary context.

In the context of testing, the term validity is used to describe the extent to which a test fulfils its purpose [35(p61)]. In this study we consider the interpretation of test scores for ambiguity tolerance and their relevance to the proposed use of the TAMSAD scale to assess ambiguity tolerance in the undergraduate veterinary student population. Reliability refers to the reproducibility of the scores. If scores between two versions or sittings of the same test are not reproducible, it becomes difficult or impossible to interpret the meaning of the scores. Hence reliability is important in establishing a validity argument.

We hypothesise that:

1. The TAMSAD scale can be adapted to produce a valid and reliable measure of ambiguity tolerance in undergraduate veterinary students
2. The factor structure of the ToA construct will be similar in medical and veterinary students supporting the interpretation of the scale as a unidimensional measure of tolerance of ambiguity.

Materials and Methods

Study design

The study consisted of three phases:

1. Selection and adaptation of an instrument for use with veterinary undergraduates (including survey pilot and preliminary content validation)
2. Use of the adapted TAMSAD instrument to assess undergraduate veterinary students self-reported ambiguity tolerance
3. Analysis of response data to evaluate the reliability and validity of the instrument for use with veterinary students.

Ethical approval for the study was granted by the College of Medical, Veterinary and Life Science ethics committee.

Context

The study took place at a Scottish school of veterinary medicine. Participants were drawn from current undergraduate students studying a Bachelor of Veterinary Medicine and Surgery (BVMS) degree accredited by the Royal College of Veterinary Surgeons, the European Association of Establishments for Veterinary Education and the American Veterinary Medical Association.

The BVMS is a 5 year programme. Years 1 & 2 comprise a system-based integrated course with an emphasis on early clinical skills development in simulated (but typically not clinical) settings. Years 3 & 4 focus on clinical training across the major domestic species and disciplines; although the course is primarily lecture-based there is continued emphasis on clinical and professional skills development. Students in their final year complete 32 weeks of clinical placements, which include multi-species core and elective opportunities.

In common with other UK veterinary schools**,** BVMS students are required to complete 38 weeks on extra mural studies (EMS) over the course of their training. This comprises 12 weeks of preclinical EMS with a focus on animal handling and husbandry followed by 26 weeks of clinical EMS, usually spent in a range of veterinary practice settings.

Scale adaptation & review

Consistent with the aims of the study, 5 criteria for selection of scale were agreed: focus on ambiguity tolerance, suitability of the scale for an undergraduate context, scale items which reflected a clinical or clinical-education context, items which required minimal adaptation for use in a veterinary context, good internal reliability of the scale in reported study populations. Following a

review of the literature, 5 published scales for evaluating AT and related constructs in the medical context were evaluated for adaptation for use with veterinary undergraduates: Budner's original scale [13], Physicians reactions to uncertainty [2,36], M-STAT [37], TAMSAD [4] and Gellers scale[28]. The TAMSAD scale was the only one to meet all of the selection criteria and was chosen for further development.

The TAMSAD instrument is a 29 item scale which asks participants to self-assess their responses to statements relating to ambiguity in clinical, professional and educational contexts. Items are scored on a 5 point Likert scale (where 1 = strongly disagree and 5 = strongly agree). The scale was initially developed to study ambiguity tolerance in medical students and practicing physicians at the University of Exeter and took the form of a 41 item instrument which was subsequently revised based on published validity data [4]. The scale includes both positively and negatively worded items. Negatively worded items are reverse scored prior to analysis.

As the factor structure and characteristics of ambiguity tolerance between veterinary and medical student populations could not be assumed to be identical, the full 41 items described in the original TAMSAD scale were included in the scale initially used for this study.

Scale items were reviewed by the primary author (a veterinarian) and a colleague (veterinary nurse) to assess the extent to which their content and wording was appropriate for the veterinary context. 23 items were reworded to improve their relation to the veterinary environment – most of these were minor changes such as changing "patient" to "client" or "Doctor" to "Vet". Two items needed more significant rephrasing (Q5 and Q31) as they referred to specific specialty areas and verbal communication with a patient – see Appendix 1 for final wording. No items were considered to be wholly inappropriate for the veterinary context.

Additional survey questions were added at the start of the questionnaire including an opportunity to provide informed consent, basic demographic data (age, gender, and nationality), information about previous education, stage of training and likely career direction. Outcomes of this will form the basis of a separate study and are not included here

The survey form was piloted with a small group of students in years 3 & 4 (N=6) who were asked to evaluate the items both for relevance to the construct of ambiguity tolerance, and to make suggestions to improve the clarity of the survey form and items. Based on this process, minor modifications were made to the items asking about nationality and career direction, but no changes were made to the adapted scale items.

Participants and recruitment

All students currently enrolled in years 1-4 of the BVMS Programme were invited to participate in the study. For those who consented to participate, a paper copy of the survey was made available at the end of a course activity (e.g. lecture or practical session). For those who preferred, an online version was also provided. Students in final year are typically on clinical rotations and, as such, could not be included in the study. Data collection for the survey validation took place between January and May 2014. In total, data were collected from 292 participants (98 males; 193 females, 1 unknown). A majority (87%) of participants were aged between 18-25 years. 108 of the 292 students had completed a degree prior to enrolling on the BVMS programme.

Statistical analysis & results

Initial analysis

Data analysis was conducted in SPSS version 22. We calculated survey response rates for each year group. Response rates for each cohort group are shown in Table 1. Very good response rates were achieved for 1st and 2nd year students. Response rates for years 3 & 4 were suboptimal.

Insert table 1 here

Negatively worded items were reverse scored prior to analysis. Three outliers were identified using the Mahalanobis Distance Method[38] ($p<0.001$) and these were examined and excluded from further analysis. All three participants had failed to answer multiple (50%) survey items.

A number of measures indicated that data were suitable for factor analysis: the Kaiser-Meyer-Olkin Measure of sampling adequacy was 0.64, above the recommended value of .6, (for 41 item scale) and Bartlett's test of sphericity was significant ($p<0.01$)[39]. The minimum amount of data for factor analysis was satisfied, with a final sample size of 287 (using list-wise deletion).

Factor analysis

The aim of the analysis was to establish how many dimensions (or factors) are needed to characterise the variation in the data. The degree to which these dimensions match the theoretical dimensionality of the construct is one way to evaluate how well the test matches the construct. In the case of AT, however, the limited theoretical basis of the construct makes this challenging. For this reason an exploratory factor analysis approach was taken; (see Appendix 1 for details).

Initially, the factorability of the 41 TAMSAD items was examined. Although 15 components had an Eigenvalue>1, only 3 of these explained a proportion of the variance over 5% each, the fourth explained 4.5% of the variance and based on interpretation of the scree plot (looking for a levelling and distinct elbow) was included in the final structure. The four components cumulatively explained only 26% of the variance. Each component was then reviewed for a consistent conceptual meaning. A 4 factor structure was proposed for further consideration and Cronnbach's α was calculated to assess the internal consistency for each of the sub-scales; Appendix 1 shows the factor matrix based on the 4 factor structure. Table 2 shows the features of the proposed factor structure.

Insert table 2 here

These analyses indicate that although 4 factors could be identified as potentially underlying veterinary student responses to the TAMSAD scale items; these factors had poor internal consistency and together were able to explain only 26% of the variance in the data. Based on this it was considered more appropriate to adopt the approach taken by McLain and others [40] and consider these as facets of the construct rather than factors *per se*. This supports the view that ambiguity tolerance is a unidimensional but multifaceted construct. The key distinction is that a multi-faceted unidimensional structure describes factors (facets) which are related or correlated in some way, whereas a multidimensional structure is used to describe factors which behave independently[41(p14)].

Reliability analysis and TAVS (Tolerance of ambiguity in Veterinary students) scale development

Internal consistency (Cronbach's α) calculated for the 41 item full measure (α = 0.50) and the 29 item TAMSAD measure (α = 0.55) suggested only moderate reliability.

In order to improve the reliability and parsimony of the scale as well as reducing the length of time it would take to complete; items were removed if they did not improve the value of Cronbach's α for the overall scale or if the adjusted item total correlation with the remaining items was <.020. On this basis, 12 of the 41 items with poor correlation to the overall scale were removed.

The range of participant responses was calculated for all remaining items, with the aim of improving the parsimony of the scale by removing items where participants used only a narrow range of response options. All items had a range of 4 or 5 (of 5 possible response options) and therefore no item was removed on this basis.

Of the remaining 29 items (α = 0.66), items 5 & 15 were considered inappropriate for inclusion in the TAVS scale as they related specifically to career choice, and could limit the applicability of the scale for further studies considering ambiguity tolerance and career choice. The final 27 item TAVS scale had acceptable internal consistency (α = 0.67).

Appendix 2 shows items which were included in the final TAMSAD scale and those included in the final TAVS scale. Of the original 41 items considered, 22 items were common to the final versions of both TAMSAD and TAVS scales.

The items mapping to each of the proposed facets of the structure were reviewed for the TAVS scale. Although a number of items mapping to facet 4 are lost in the final TAVS scale, the scree plot shows a similar pattern using 27 items as with 41 items and the 4 factors now account for 33% of the variance in scores. The final TAVS scale therefore has improved reliability and parsimony when compared with the longer scales, and retains a multifaceted but unidimensional structure.

Discussion

Validity argument

In keeping with the original TAMSAD scale we evaluated the validity of this scale using an established framework[42] set out by the American Psychological Association National Council on Measurements in Education and applied to the medical education context by Downing [43]. This framework sets out the five aspects of validity that should be considered when making a validity argument for the use of any tool: content validity, response process, internal structure of the scale, the relationship to other variables and the consequences of using the scale measure.

Content

An argument for the content validity of the original TAMSAD scale was made based on comprehensive literature search, development of previous scales, and input from senior clinicians and academics. In our case the TAMSAD scale was examined by the study team and felt to be relevant to the veterinary student population following modification of the wording of a number of scale items.

The adaptation of a scale used with medical students is a rational approach but it is important to acknowledge that although veterinary and medical programmes typically adopt similar structures,

there are also significant differences between training programmes. These differences may mirror the scope of eventual professional practice in each area, which for vets may include differing species and approaches to practice. It is possible that the scale content, while appropriate, does not yet capture all features of ambiguity tolerance in a Veterinary context. For example; the need to consider animal as well as human and societal interests means that veterinary practitioners frequently encounter ethical dilemmas [44]; the ethical approach to veterinary practice can be complex[45] and challenging[46] which may have an impact on the types of ambiguity and sources of uncertainty encountered by veterinary professionals.

Response process

Self-report scales are commonly used for psychological testing and the Likert scale response is sufficiently ubiquitous in contemporary life that student cohorts will be familiar with the response format. Evaluation of the response process in this study was based on piloting of the scale with a small group of undergraduate students. The main limitation in using a self-report scale to evaluate ambiguity tolerance is the potential for response bias to influence outcomes. The use of multiple reverse coded items in the TAMSAD scale reduces the risk of acquiescence and non-acquiescence bias [47]and these items have been maintained in the TAVS scale. Other biases such as socially desirable responding and extreme response bias are more challenging to correct for. Extreme response bias is interesting in the context of this study because intolerance of ambiguity (as well as other factors such as cultural background) have been reported to correlate with extreme response style [48]. Measures of extreme response styles have been proposed in the literature[49] and future work could attempt to evaluate the way in which extreme response styles may influence self-report scales of ambiguity tolerance.

Internal structure

Although the original measure of ambiguity tolerance developed by Budner in 1962 is widely used, it has been criticised for poor internal reliability, with α as low as 0.44[50] and 0.49[13] reported in a number of studies. The final TAVS 27 item scale has internal reliability ($\alpha = 0.67$), which is considered acceptable, although it does not reach the level reported for the original TAMSAD scale ($\alpha = 0.8$) [4]. This may be because of limited relevance of scale items to a veterinary context or subtle differences between the contexts of the two study populations and how individuals relate the wording of scale items to their experiences. It is unlikely to relate to differences in sample size, as these were similar between the two studies (287 responses for the current study, 310 responses for Hancock et al 2014). Other published scales for assessment of ambiguity tolerance vary in internal consistency, although many achieve α over 0.8[15].

We propose that our data support the conceptualisation of the scale as a unidimensional measure with four discrete facets. A number of studies have considered the dimensionality of ambiguity tolerance and the varying dimensions proposed (between 1 and 8) are summarised in the review by Furnham[15]. None of the previously published factor descriptions is identical to the facets described in this study, although there are a number of similarities; for example the label “affinity for complexity” relates to McLain’s factor of “complexity”[40] and the label “accepting indeterminacy” shares some similarity with the label “change” used by both Herman[31] and McLain[40].

Although the overall factor structure of the ToA construct appears to be similar in medical and veterinary students, supporting the interpretation of the scale as a unidimensional measure of tolerance of ambiguity, the identification of 4 underlying facets in veterinary students suggests that there may be differences in how the two study populations interact with the scale.

Relationship to other variables

The relationship between TAVS-scale outcomes and other variables is difficult to determine with this population as levels of tolerance of ambiguity in veterinary students have not been assessed previously. In medical student populations we know that certain variables such as stage of training, gender, graduate entry status are related to tolerance to ambiguity [28] and these could be used to develop hypotheses for testing relationships of TAVS scores to other variables in a Veterinary context.

Consequences

At this stage in the scale development process, the most significant consequence is the time taken to complete the measure which, at only 27 items long, is likely to have minimal adverse impact on participants. Although the use of similar scales has been proposed for the purposes of student selection in other professional groups[16], we believe that this suggestion should be treated with caution, particularly as there is limited collective understanding of the theoretical basis or potential consequences of doing so. Use of the TAVS scale in further research will allow relevant evidence to be developed in the Veterinary context.

Strengths and limitations

Although survey response rates in earlier years of the programme were excellent, the low response rates among students in 3rd and 4th year groups is a limitation of this study. As the survey methodology was the same for all student groups it is unlikely that this would influence response rate, but this may reflect differences in the context in which the surveys were conducted in these groups or may indicate survey fatigue in students at this stage of training (for example, through experience of course evaluation surveys over the previous 2-3 years)[51]. We believe that this is unlikely to have a significant impact on claims for validity of the scale in the veterinary undergraduate population; future studies could compare psychometric features and dimensionality of the scale between cohorts which would provide further support for validity. The exclusion of the 5th year cohort may be more important; the clinical and workplace emphasis of the final year of the veterinary programme provides a new perspective and is likely to increase students' exposure to potentially ambiguous situations. Validation of the scale with students at this stage of training should be a priority for future research.

Conclusions

Based on the stated hypotheses, we conclude that the TAMSAD scale can be adapted to produce a valid and reliable measure of ambiguity tolerance in undergraduate veterinary students. Although the 29 item TAMSAD scale has acceptable reliability in veterinary students, the 27 item TAVS scale has better internal reliability in the context of veterinary undergraduates. As both scales share

multiple items, use of a 22 item combined scale would facilitate future comparison of the two groups.

Although the factor structure of the ToA construct appears to be similar in medical and veterinary students, supporting the interpretation of the scale as a unidimensional measure of tolerance of ambiguity, the identification of 4 underlying facets in veterinary students may further illuminate the nature of the ambiguity tolerance construct and features unique to a veterinary context. Indeed, use of this scale should be considered as part of research into potential links between levels of ToA and mental health morbidity in the veterinary and medical student populations.

Future directions

Further work should focus on establishing the content validity of scale items across a variety of veterinary careers including practitioners and postgraduate students. This may require the development of additional scale items to capture unique elements of ToA in veterinary contexts. This would facilitate use of the scale to compare student and practitioner levels of ToA and evaluation of whether acknowledged links between ToA and mental health and wellbeing in other populations are indeed significant in veterinary students.

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Appendix 1

Factor analysis showing item loadings for the 4 proposed facets: 1: novice view, 2: discomfort from uncertainty, 3: affinity for complexity and 4: accepting indeterminacy

	Factor Matrix[a]				
Item		Factor			
		1	2	3	4
1	The beauty of veterinary medicine is that it's always evolving and changing.	.517			
2	It is more interesting to tackle a complicated clinical problem than to solve a simple one.	.470	-.118		.277
3	A patient with multiple diseases would make a vet's job more interesting.	.451		.102	.206
4	A good clinical teacher is one who challenges your way of looking at clinical problems.	.448			-.184
5	I like the challenge of being thrown in the deep end with different veterinary situations.	.443	.150	.174	.157
6	I enjoy the process of working with a complex clinical problem and making it more manageable.	.423			.122
7	I enjoy working out which opinion is right in situations where many different opinions are expressed.(RC)	-.399			
8	I like the mystery that there are some things in veterinary medicine we'll never know.	.352	.194	.274	.141
9	I would enjoy tailoring treatments to individual patient problems.	.339		-.183	
10	I enjoy reducing detailed scientific problems to their core concepts.	.326	-.115	.225	
11	It's an exciting feeling when you listen to a client tell you their animal's symptoms and you just know what disease it is.(RC)	-.311	.212	.174	
12	I am comfortable to acknowledge that I'll never know everything about veterinary medicine.	.306	.109		-.122
13	'I don't know' are really important words in veterinary medicine.	.280	.126		-.146
14	I would be comfortable to acknowledge the limits of my veterinary medical knowledge to clients.	.231			
15	I think it is important to attribute a percentage likelihood to a diagnosis or a specific patient outcome.	.224			
16	I am apprehensive when faced with a new clinical situation or problem.(RC)	-.173			
17	I enjoy reducing the complexity of veterinary medical information to something more tangible.	.139	-.114		
18	Being confronted with contradictory evidence in clinical practice makes me feel uncomfortable.(RC)	.140	.484		.179

19	I find it frustrating when I can't find the answer to a clinical question.(RC)	-.147	.459	.373	
20	Variation between individual patients is a frustrating aspect of veterinary medicine.(RC)	.126	.439		.167
21	I am uncomfortable that a lack of veterinary knowledge about some diseases means we can't help some patients.(RC)		.423	.125	
22	I feel uncomfortable knowing that many of our most important clinical decisions are based upon insufficient information.(RC)		.409		
23	I think in veterinary medicine it is important to know exactly what you are talking about at all times.(RC)		.399	-.234	
24	I feel uncomfortable when textbooks or experts are factually incorrect.(RC)	-.123	.381	.260	
25	A good job is one where what is to be done and how it is to be done are always clear.(RC)		.369	-.129	
26	No matter how complicated the situation, a good Vet will be able to arrive at a yes or no answer.(RC)	.152	.348	-.275	-.217
27	As a vet I would prefer the clear and definite work of someone like a surgeon to the uncertainties of a behaviour specialist.(RC)	-.206	.258		
28	In veterinary medicine as in other professions, it is possible to get more done by tackling small, simple problems rather than large and complicated ones.(RC)	-.146	.223	-.152	.182
29	I would prefer to work in a veterinary specialty where patients normally get better after treatment.(RC)		.112		
30	To me, veterinary medicine is black and white.(RC)	.320	.176	-.416	-.220
31	It is important to appear knowledgeable to clients at all times.(RC)			-.403	.311
32	A Vet who leads an even, regular work life with few surprises, really has a lot to be grateful for.(RC)			-.327	
33	The unpredictability of a patient's response to medication would bring welcome complexity to a Vet's role.	.197		.309	
34	I feel comfortable that in veterinary medicine there is often no right or wrong answer.	.249	.137	.299	-.151
35	What we are used to is always preferable to what is unfamiliar.(RC)		.258	-.297	
36	I would be comfortable if a clinical teacher set me a vague assignment or task.			.287	
37	Even when there is conflicting information, I prefer to make a decision and move on. (RC)	-.248		-.285	-.190
38	I have a lot of respect for specialist Vets who always come up with a definite answer.(RC)	-.185		-.221	.100
39	There is really no such thing as a clinical problem that can't be solved.(RC)	-.147		.186	-.475
40	Veterinary medicine has a lot of grey areas because we haven't	-.374		.222	.412

	found the answers yet. (RC)				
41	I feel uncomfortable when people claim that something is 'absolutely certain' in veterinary medicine.	.156	-.165		-.170

Extraction Method: Principal Axis Factoring. Promax rotation procedure with Kaiser normalisation[52]

a. 4 factors extracted. 6 iterations required. RC=reverse coded

Appendix 2:

The 41 scale items used in the study and subsequent use in TAMSAD/TAVS scales. Values for Cronbach's α if item deleted and item total correlation are shown for each scale item. (RC) items were reverse coded prior to analysis.

Scale item	Item text	Corrected Item-Total Correlation)	Cronbach's Alpha if Item Deleted	Included in 29 item TAMSAD scale	Included in 27 item TAVS scale
Q1	I am comfortable to acknowledge that I'll never know everything about veterinary medicine.	.169	.472	No	Yes
Q2	Even when there is conflicting information, I prefer to make a decision and move on. (RC)	-.107	.504	No	No
Q3	I would enjoy tailoring treatments to individual patient problems.	.214	.470	Yes	Yes
Q4	I think it is important to attribute percentage likelihood to a diagnosis or a specific patient outcome.	.073	.484	No	Yes
Q5	As a vet I would prefer the clear and definite work of someone like a surgeon to the uncertainties of a behaviour specialist.(RC)	.082	.484	No	No
Q6	I have a lot of respect for specialist vets who always come up with a definite answer.(RC)	-.040	.497	Yes	No
Q7	I would be comfortable if a clinical teacher set me a vague assignment or task.	.019	.492	Yes	No
Q8	A good clinical teacher is one who challenges your way of looking at clinical problems.	.258	.467	Yes	Yes
Q9	What we are used to is always preferable to what is unfamiliar.(RC)	.190	.469	Yes	Yes
Q10	I feel uncomfortable when people claim that something is 'absolutely certain' in veterinary medicine.	-.024	.497	Yes	No
Q11	A vet who leads an even, regular work life with few surprises, really has a lot to be grateful for.(RC)	-.007	.495	Yes	No
Q12	I enjoy reducing the complexity of veterinary medical information to something more tangible.	-.054	.497	No	No
Q13	I think in veterinary medicine it is important to know exactly what you are talking about at all times.(RC)	.206	.467	Yes	Yes
Q14	'I don't know' are really important words in veterinary medicine.	.193	.468	No	Yes
Q15	I would prefer to work in a veterinary specialty where patients normally get better after treatment.(RC)	-.036	.500	No	No
Q16	I enjoy reducing detailed scientific problems to their core concepts.	.078	.484	No	Yes
Q17	I feel comfortable that in veterinary medicine there is often no right or wrong answer.	.197	.468	Yes	Yes
Q18	A patient with multiple diseases would make a vet's job more interesting.	.127	.478	Yes	Yes
Q19	I am uncomfortable that a lack of veterinary knowledge about some diseases means we can't help some patients.(RC)	.233	.464	Yes	Yes
Q20	The unpredictability of a patient's response to medication would bring welcome complexity to a Vet's role.	.099	.481	Yes	Yes
Q21	It is important to appear knowledgeable to clients at all times.(RC)	-.122	.515	Yes	No
Q22	Being confronted with contradictory evidence in clinical practice makes me feel uncomfortable.(RC)	.324	.453	Yes	Yes
Q23	I like the mystery that there are some things in veterinary medicine we'll never know.	.253	.460	Yes	Yes
Q24	Variation between individual patients is a frustrating aspect of veterinary medicine.(RC)	.263	.458	Yes	yes
Q25	I find it frustrating when I can't find the answer to a clinical question.(RC)	.227	.466	Yes	Yes
Q26	I am apprehensive when faced with a new clinical situation or problem.(RC)	-.009	.496	Yes	No

Q27	I feel uncomfortable knowing that many of our most important clinical decisions are based upon insufficient information.(RC)	.206	.469	Yes	Yes
Q28	No matter how complicated the situation, a good Vet will be able to arrive at a yes or no answer.(RC)	.285	.456	Yes	Yes
Q29	I feel uncomfortable when textbooks or experts are factually incorrect.(RC)	.190	.469	Yes	Yes
Q30	There is really no such thing as a clinical problem that can't be solved.(RC)	-.027	.500	Yes	No
Q31	It's an exciting feeling when you listen to a client tell you their animals symptoms and you just know what disease it is.(RC)	.001	.492	No	No
Q32	I like the challenge of being thrown in the deep end with different veterinary situations.	.252	.461	Yes	Yes
Q33	It is more interesting to tackle a complicated clinical problem that to solve a simple one.	.100	.481	Yes	Yes
Q34	In Veterinary medicine as in other professions, it is possible to get more done by tackling small, simple problems rather than large and complicated ones.(RC)	.058	.486	No	Yes
Q35	I enjoy the process of working with a complex clinical problem and making it more manageable.	.081	.483	Yes	Yes
Q36	A good job is one where what is to be done and how it is to be done are always clear.(RC)	.267	.459	Yes	Yes
Q37	Veterinary medicine has a lot of grey areas because we haven't found the answers yet. (RC)	-.107	.503	No	No
Q38	To me, veterinary medicine is black and white.(RC)	.168	.474	Yes	Yes
Q39	The beauty of veterinary medicine is that it's always evolving and changing.	.193	.471	Yes	Yes
Q40	I enjoy working out which opinion is right in situations where many different opinions are expressed.(RC)	-.193	.514	No	No
Q41	I would be comfortable to acknowledge the limits of my veterinary medical knowledge to clients.	.109	.480	Yes	Yes

Table 1

		Frequency	Percent	Year size
Valid	1st year BVMS	108	90	120
	2nd year BVMS	115	89	128
	3rd year BVMS	46	35	128
	4th year BVMS	23	18	128
	Total	292	58	504

Table 1: Survey response rates by year of training

Table 2

Proposed factor	Number of scale items	Example items	Internal consistency of subscale (α)
1. Novice view	11	To me, Veterinary medicine is black and white. No matter how complicated the situation, a good Vet will be able to arrive at a yes or no answer.	0.24
2. Discomfort from uncertainty	12	Being confronted with contradictory evidence in clinical practice makes me feel uncomfortable. I find it frustrating when I can't find the answer to a clinical question.	0.54
3. Affinity for complexity	8	It is more interesting to tackle a complicated clinical problem than to solve a simple one. A patient with multiple diseases would make a vet's job more interesting. I like the challenge of being thrown in the deep end with different Veterinary situations.	0.31
4. Accepting indeterminacy*	10	I feel comfortable that in veterinary medicine there is often no right or wrong answer. I would be comfortable if a clinical teacher set me a vague assignment or task.	0.21

Table 2: Summary of proposed factors identified from factor analysis. Indeterminacy is defined as not being certain of the final outcome, and is closely related to probability*[5]