Mapping Occupations into Vocational Interests: Two Case Studies

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We consider techniques for combining self-descriptions from people who occupy some vocational niche, so as to describe the ideal characteristics of a prototypal member of the occupation, and delineate the requirements of the niche. Such prototypes would be most useful in recruitment or in vocational guidance if they were worded in terms of a general descriptive language, applicable across occupations. Here a vocational-interest inventory, the VOC-99, provided the common language. Data from two samples were converted to prototypal combinations of interests; these were expressed as the values of three broad summary scales, each one corresponding to one dimension of a spatial 'map' of the VOC-99. A first sample of market researchers characterized the aptitudes and preferences of the "ideal market researcher", by rating the interest items along a 5-point scale. A second sample of survey interviewers used the inventory to describe themselves, endorsing or rejecting items by following a three-way forced-ranking task. The results for survey interviewers show some predictive value when the VOC-99 is used as part of the assessment procedure in the selection of job applicants.

Most researchers in the field of vocational counselling would accept that for a given vocational role (an occupation or career path), there is an optimal combination of traits of personality or intellect or character, such that possession of those traits is associated with increased satisfaction and performance in the role. This is the congruence hypothesis (Holland, 1985). It also seems reasonable to expect the individuals occupying the role to display this combination of traits more frequently than the population at large (this follows from the assumption that there is some job mobility; and that individuals are more likely to stay in a job, once they find one which is matched to their skills and character). In other words, round pegs tend to seek out round holes. One sometimes finds the expectation justified by a 'birds of a feather' argument, as follows: if a particular personality or character is common in an occupational niche, then the happiness and productivity of a prospective employee who displays the same traits will be enhanced by the like-minded company. "Congruent environments provide job satisfaction for the subjects because they are among people with similar tastes and values to their own, and where they can perform tasks which they enjoy and are able to do" (Furnham, 1992, p. 101).[1]

In consequence, a vital component of any comprehensive system for vocational counselling is a database of occupations, profiled in terms of optimal traits and interests. A first example out of many is the software package Kudos (CASCAid, 2006), which includes the core 'aspects' and more peripheral activities associated with 1700 kinds of work, and can match these to a job-seeker's preferences among the entire inventory of activities. Second, the Dictionary of Holland Occupational Codes (Gottfredson & Holland, 1996) assigns a primary, secondary and tertiary category to each of 12,860 occupations. Categories come from a six-fold system (Realistic, Investigative, Artistic, Social, Enterprising, Conventional), so a typical code might be the acronym R-I-E. The same system underlies the ACT interest inventory (Swaney, 1995) and the US Department of Labor's O*NET database (2003).

But profiling even one occupational niche is not trivial: it requires in-depth knowledge, and a fine-grained analysis of the duties associated with the niche. For instance, Sackett, Cornelius and Carron (1981) used 237 task statements to break down the role of "Chemical processing-plant foreman". Difficulties stand in the path of directly questioning 'Subject matter experts' who work in the occupation in question (Harvey, 1991; Morgenson & Campion, 1997). Moreover, new jobs and careers are continually emerging as economies evolve (even as old ones fade into obsolescence), and one can understand why whole bureaucracies are required simply to categorize and profile them.

A corollary of the congruence hypothesis is that the desired information is present in the average personality

1. An anonymous reviewer has pointed out that the congruence hypothesis may be less applicable, and diversity of abilities is more important, in situations where employees work in groups. Belbin (1993) described nine team roles, mutually complementary, so the group's performance is maximised if each role has at least one team member capable of filling it.

profile of current incumbents of the niche. This inspires the approach of "incumbent profiling". Armstrong, Smith, Donnay and Rounds, (2004) collected data on 25 Basic Interest Measures (from the Strong Interest Inventory), for male and female incumbents of 99 occupations. They went on to represent those occupations as points in a three-dimensional spatial model, by applying multidimensional scaling (MDS) to the matrix of correlations between pairs of profiles, and then to insert vectors within the model, which represented various occupational variables from the O*NET database (such as various interest areas, knowledge areas, and technical skills). Swan (2005) compared the mean scores for 411 female carpenters on the six summary scales of the Self-Directed Search, against scores for male carpenters and for male and female normative samples. Prediger and Vansickle (1992) obtained mean RIASEC scores for the incumbents of 51 broad occupational groupings. This was a longitudinal, prospective study, in which the RIASEC scoring occurred while subjects were still at secondary school. In a further reduction of the six mean scores, Prediger and Vansickle characterised each group by its location in a two-dimensional 'World of Work'.

However, there are problems with taking incumbents of some position to collectively represent the ideal incumbent. They might score higher than the wider population on some particular trait or traits, but an even higher score might be still more desirable. In other words, their average might depart from the wider population in the direction of the optimal combination of traits, without actually attaining an optimum. After all, one cannot assume that the optimal combination of traits has been sufficiently common to fill all the vacancies in that job; at most, one can argue that the incumbents were the best people available at the time when they followed that career path.

It may be that the information obtained from incumbents is best expressed as the departure of the average from baseline levels. In this case, a relative mean profile may be a better guide to occupational prototype, for purpose of recruitment and guidance, than the absolute profile. In other words, rather than asking "What kind of people are doing this work?", it is possibly more fruitful to ask "In what ways do the people doing this work differ from the population at large?"

In this report we consider two ways of enhancing the contrast between incumbents and the population at large. One approach is to invite respondents to describe a prototypic or ideal example of their occupation – in effect, to perform the baseline comparison themselves, by detailing how the prototype differs from the lay population. The second approach, available when respondents can be graded or ranked by their levels of past performance, is to identify trends among them, and spell out what distinguishes more-effective incumbents.

We demonstrate how a given vocational niche can be described by collecting self-report data from incumbents, and analyzing them by multivariate regression within a spatial model of 'interest' or 'activity space'. The dimensions of the space provide the terms in which the description is worded. The aptitudinal requirements of the two examples are profiled using the VOC-99, an instrument consisting of 99 work descriptions from a fine-grained breakdown of occupations into their activities, designed for quantifying vocational preferences and interests (Bimler & Kirkland, 2005, 2006). Each item is a brief predicate which respondents reject or endorse according to the appeal to them of that form of activity. Examples are "Working with young children", "Operating big machinery", "Working with others as part of a team".

The framework for analyzing the data is the same in both case studies. It consists of a three-dimensional spatial model of "interest space", in which each VOC-99 item is represented by a point, and the dimensions are underlying gradients or distinctions. For instance, we interpret the first dimension D1 as a 'people / things' dimension. The points were located by applying multidimensional scaling (MDS) to estimates of inter-item similarity (Bimler & Kirkland, 2005), so that distances between item-points in the model correspond to dissimilarities between the corresponding items (measuring distances with the usual Euclidean definition, rather than alternatives such as the "city-block metric").

Each of the three coordinates pinpointing an item within the space corresponds to its value on one of the underlying gradients. In the context of interpreting someone's responses, each coordinate indicates what endorsement or rejection of that item would say about the respondent's own position along that gradient. For instance, endorsement of an item with a negative value on D1 is evidence that the respondent is oriented towards working with people.

The VOC-99 is not intended to supplant the various instruments and interest inventories that already exist – examples include the Career Interest Test (Athanasou, 2002), the Jackson Vocational Interest Survey or JVIS (Jackson, 1977), the Kuder Career Search (Kuder, 1977), and UNIACT (Swaney, 1995). It serves here as a non-proprietary research tool. The emphasis is not on its specific items, but on the underlying dimensions which emerged from analysis of their internal structure. These dimensions are empirical and reasonably general, because no particular theory of occupational cognition determined the selection of the VOC-99 items.

In many of those existing instruments, items are targeted to measure one or another of a small number of constructs (six of them in the Holland paradigm), and analysis consists of aggregating responses from all the nearly-synonymous items in each class, into a single scale. One distinguishing quality of the VOC-99 is that items are not clustered in a small number of groups. Even so, similar dimensions can be discerned within more theory-driven item inventories (Day, Rounds & Swaney, 1998). Thus the procedures presented here for summarizing responses and exploring vocational niches should generalize to those alternative instruments.

An individual's relative preferences among the VOC-99 items (or a group's average preferences) may be compatible or incompatible with the model. A compatible set of preferences is one which follows a smooth distribution when they are plotted in interest space, from highly-endorsed (preferred) items on one side of the model, trending down

to least-preferred or rejected items on the side diametrically opposite. This compatibility can be measured by multivariate correlation. A second outcome of multivariate regression is the direction of the gradient of increasing preference. This direction is a summary of the 99 preference values; its three components represent the relative importance, to that respondent, of the three dimensions of interest space.

The first dimension has already been identified as a gradient from preferences and activities oriented to 'people', up to orientation to 'things'. The second dimension runs from Indoor or cerebral activities at one extreme, to Outdoor or physical activities at the other. The third dimension runs from Creative activities at one extreme to Routine ones at the other. This does not exhaust the structure underlying the VOC-99, and there are reliable indications of a fourth dimension, where the two extremes are internally-focused self-reliance, and external focus or working with others. We focus less on this distinction because its contribution to inter-item dissimilarity is small compared to the first three axes.

1. Market research practitioner study.

A panel of 24 market-research practitioners provided data in the course of a conference presentation, the 2003 Conference of the Market Research Society of New Zealand (MRSNZ). The panel was heterogeneous: they worked in public-sector as well as private roles, focusing on qualitative as well as quantitative research. The sample was also self-selected: the members of MRSNZ, who chose to attend the conference and to participate in this presentation, are not necessarily representative of market researchers in general. Nevertheless, we regard them as the best experts on what makes a good market researcher, from their experience of their own and of their colleagues' performance in the role. They had already carried out the hard work of 'vocational profiling' (observing and abstracting from the activities of people as they function in market research). All that remained for us was to provide the panel with a standard language in which to express their conclusions.

Procedure: To work within the available time, every second VOC-99 item was omitted, leaving a manageable but representative concourse of 45 items. The item set contains enough redundancy that when the data are summarised in broad terms (below), the outcomes are not greatly affected by the absence of values for half the items (Bimler & Kirkland, 2006); 45 items still sample the domain thoroughly. Each panel member gave each item a rating vqi according to its degree of association with the 'prototypic market researcher', from - 2 (least associated) to 2 (most associated). 'Association' was glossed as the likelihood or desirability of a randomly-chosen member of the profession expressing each activity or interest.

Analysis:

Multivariate regression attempts to predict (or rather postdict) values of a dependent variable – here, the ratings given to the 45 items by the q-th respondent – by a weighted sum of dependent variables, which in this case are the coordinates of those same items on the three dimensions of 'interest space'. By way of analogy, someone's preferences for accommodation in a (simplified) city might be described as a combination of three combinations from the North / South locations of the available options, their East / West locations, and their altitudes (number of storeys).

The regression renders down the respondent's preferences to weights on the first, second and third dimensions. Since it is awkward to describe these weights in full each time, we can refer to them as PT_q, IO_q and CR_q. They can be positive or negative. For instance, a negative value for PT_q means that items with positive coordinates on the first dimension (i.e. oriented to 'things' rather than 'people') tend to appeal less to the respondent (and vice versa). "Job Valuer / Salary Estimator" (O*Net occupation 13-1072) illustrates the combination "People, indoors, routine" or $-PT_q$, $-IO_q$, $+CR_q$.

These weights can be read as components of a vector in interest space – a direction of increasing preference (just as accommodation options might become more appealing if every step of two blocks Eastward is accompanied by a step of one block Northward and one storey higher). The other outcome is the multivariate correlation Rq, ranging from 0 to 1 and describing the accuracy of 'postdictions' for that respondent.

Results:

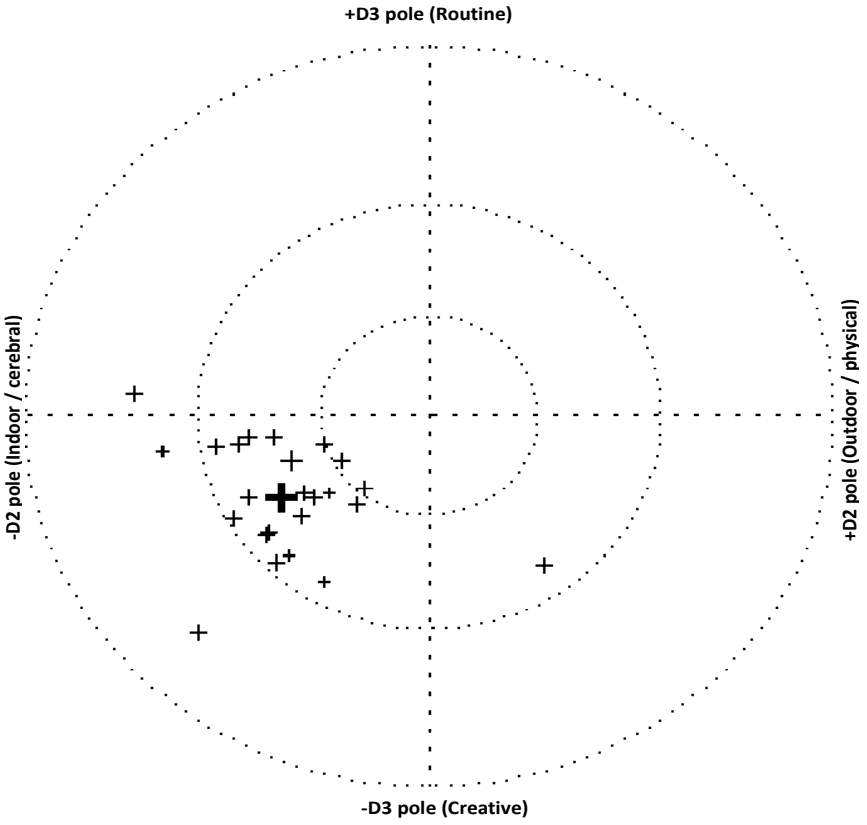
The correlations Rq ranged from 0.33 to 0.73, around a mean of 0.57 (so on average, about 1/3 of the variance in each respondent's 45 responses is explained by three vector components). That is, responses are generally compatible with the spatial model. This implies that respondents viewed the items in the same light (i.e. saw the same relationships among them) as the earlier respondents who provided the sorting and triad decisions on which the model was built. The present respondents conform to what has been called the 'cultural consensus' (Romney, Weller & Batchelder, 1986) or Weltanschauung (Day et al., 1998) about the items.

The distribution of the regression vectors deserves some attention, but to show them in two dimensions is a challenge. Imagine a notional sphere in 'interest space', centred on the origin. One hemisphere is flattened, forming Figure 1, where its rim becomes the outer circle. The crosses represent the vectors – the points where they intersect the sphere as they radiate out in various directions. In particular, this is the 'people' half of interest space (negative coordinates on the first dimension), flattened using the stereographic projection: the positive hemisphere is irrelevant because the present vectors include only negative PT_q components.

A cross at the centre of the circle would correspond to a preference for 'people'-oriented activities in unalloyed form ($PT_q < 0$, $IO_q = CR_q = 0$). A respondent who rated items purely by a preference for Routine over Creativity would be described as $CR_q > 0$, $PT_q = IO_q = 0$ and be shown as a point at "12-o'clock" on the edge of Figure 1 (where IO_q varies horizontally and CR_q varies vertically). Again, a preference for Indoor (cerebral) over Outdoor (physical) activity would yield $IO_q < 0$, $PT_q = CR_q = 0$ and appear as a point at "9-o'clock".

Individual ratings for each item were averaged, to express the panel's

Figure 1. Each cross indicates a vector or direction $\mathbf{b}_q$ within the three-dimensional MDS solution for the VOC-99 items, intersecting a notional hemisphere, and mapped onto the plane using the stereographic projection (see text). Only the 'people-oriented' hemisphere for the negative-D1 half of the solution is shown. Each vector summarises how one market researcher rated the items. Size of cross is proportional to R_q. The large bold cross indicates the panel consensus $\mathbf{b}_M$.



consensus about the ideal market researcher. Items with the highest and lowest means are listed in Table 1.

The bold cross in Figure 1 is the vector (from multivariate regression again) that sums up these mean associations in terms of a specific combination of the three dimensions. Specifically, $PT_M = 0.55$, $IO_M = 0.49$, $CR_M = 0.30$. That is, the prototypic market researcher prefers working with people rather than things; indoor rather than outdoor forms of work; and creative rather than routine tasks. We find this summary more useful than Table 1 with its item-by-item mean ratings. None of this is a great surprise but it supports the face validity of this approach. Figure 1 highlights the overall agreement about this consensus: the spread of individual vectors around the mean is small, with no major deviations away from it. This inspires confidence in the outcome.

According to the multivariate correlation ($R_M = 0.655$), expressing the ideal description in dimensional terms loses some of its finer nuances, since the vector accounts for less than half of the variance contained in the 45 mean values. Nevertheless, it captures the broad sweep. A finer-grained summary with more parameters would presumably capture more of the information within the raw data. As noted in the Conclusion, we have used a system of 10 summary indices – each an aggregate of scores from an empirical cluster of items – as another way of providing respondents with feedback.

Study 2. Statistics New Zealand Field Interviewer project

Here the occupation considered is that of "field interviewer" with Statistics New Zealand (Stats NZ for short). The job is to carry out face-to-face interviews, for surveys such as the Household Labour Force Survey. In general, street addresses are selected at random (targeting particular demographics according to the needs of the survey 'frame'), and the interviewer recruits the necessary number of participants for the survey by contacting addresses from the selection, known as making 'cold calls'. The full title of this work is "Field-based household interviewer". However, a minority of field interviewers work on a more specialized role of collecting information for the Consumer Price Index or CPI. This involves (among other things) researching the price of consumer goods and appliances, from a pre-determined list, in supermarkets, department stores, car dealerships, etc. Collecting CPI data is slightly removed from the task of recruiting survey respondents through cold calls at selected household addresses, although the CPI researcher still needs to gain the cooperation of the store manager or service provider in order to collect pricing details. The differences also include hours of work. Many survey interviewers have to concentrate their efforts during evenings and weekends in

Table 1. Items with highest and lowest mean associations with the "ideal market researcher".

Number	v_i	Text of item
53	1.92	Working with others as part of a team
42	1.88	Working with ideas
62	1.75	Working with private information
105	1.71	Using my brains as much as possible
19	-1.92	Operating big machinery
47	-1.88	Servicing heavy equipment
60	-1.83	Working with dangerous goods
12	-1.74	Working in a trade e.g. florist, electrician, plumber, hairdresser etc.

order to make contact with respondents. CPI collectors are able to collect the pricing information during store hours, which may mean early in the morning or late at night.

No rigid administrative barrier separates these two roles, and there is considerable mobility between them: many respondents in this study divided their time between both roles. Thus it was convenient to research them together. At the time of the study, Stats NZ was employing 209 field interviewers.

There is an ongoing need to recruit new interviewers, to make up for normal attrition and when new surveys are introduced. Until now, the recruitment of field interviewers has mainly been a subjective process, based on the intuition of the regional Field Supervisor to whom it fell to interview potential candidates. Results have not always been satisfactory, and Study 2 was a collaboration between Massey University and Stats NZ, with the long-term intention of eventually facilitating this interviewer-recruitment process. Various reasons might be advanced to account for unsatisfactory appointments. On one side, a prospective interviewer may have paid too little attention to aspects of the job that were overshadowed by their need for income; perhaps the job was not explained properly. On the other side, supervisors sometimes have reservations about people but feel pressured into appointing them by a lack of available candidates to choose between.

The *immediate* intention was to delineate the characteristics of existing field interviewers, as a surrogate for profiling the occupational niche itself. The 209 interviewers were therefore sent an invitation to take part in the study, with an assurance that participation was confidential and wholly voluntary. In a sealed envelope they received a cover letter; a 16-page response booklet; a stamped addressed envelope in which to return materials to Massey University for analysis; and a feedback response form for those who wanted personal analyses returned to them. Respondents would be reimbursed for their time, for up to an hour at their usual salary rate. Completed forms were sent directly to Massey University where the respondents' confidentiality and anonymity were strictly observed. Their supervisors in Stats NZ had no access to the booklets, or analyses at the individual level, or names of those who chose not to take part.

One would expect the traits and interests most associated with this particular job to receive higher ratings from those individuals who show special competence in the role. In this case we do not have direct evidence of competence, but it was possible to stratify the pool of interviewers into four bands according to salary level. It may be that staff at higher levels will display our postulated pattern of preferences in purer form.

Items.

Two items were judged to be inapplicable to adult respondents, and were not used here. These were 94, Respecting the views of older people (including parents); and 101, Doing as my elders / parents suggest. A third item was also omitted (28, Being a professional sports person), leaving 96 items, since the next step is easier when the item set is a multiple of three.

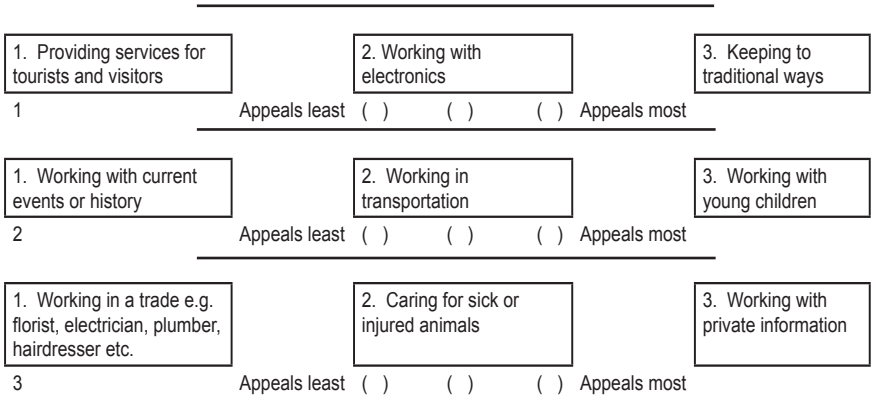
Procedure.

We generated a list of 64 "trilemmas": three-way forced-choice ranking questions. Each question provides three interest options from the VOC-99, of which the respondent must choose one as 'appeals (or applies) most', and one as 'appeals (or applies) least'. Specimen trilemmas are shown as Figure 2. The trilemmas were printed as eight pages of the response booklet. The booklet also contained one page of instructions, with examples; six pages containing 42 trilemmas for 'thinking style' items which are not considered here; and a page of additional questions about age and education, including space for comments.

Three considerations determined the choice of trilemmas. First, no *pair* of items was used in a trilemma more than once. Second, each item appeared twice across the 64 trilemmas – in a different context each time, because of the first consideration. Third, the respondent's decision was made as stark and as informative as possible, by combining items in the trilemma which were far apart in the spatial model. The rationale and algorithm for trilemma optimization are explained in more detail elsewhere (Bimler *et al*., 2005). The Kuder Career Search (Kuder, 1977) also uses forced three-way choices, though they are not optimised empirically (as here), but informed by a theory of occupational cognition. A comparable 'dilemma' technique is used in the Career Interest Test (Athanasou, 2002) and the JVIS (Jackson, 1977). There respondents opt for one of two alternatives, designed to pose a nearly diametrical opposition in a two-dimensional model of vocational choice.

Overall, the respondents coped well with the trilemma task. Four respondents left whole blocks of eight trilemmas uncompleted (presumably they had forgotten to fill in the back of one page of the booklet). More often, sporadic trilemma responses were left blank in the booklet, or were unusable. Instead of ranking the three options comprising

Figure 2 Examples of the trilemmas used in the questionnaire of Study 2.



a trilemma from most- to least-preferred, a respondent might pick two least- or most-preferred: perhaps meaning that the decision was tied. Some respondents reported that particular trilemmas posed particularly difficult decisions, and indicated a need for additional response options, to handle cases when two items are equally desirable or undesirable. There is enough redundancy in the trilemma instrument to handle such sporadic omissions. In the end only eight respondents failed to understand the demands of the task, and provided such fragmentary or aberrant data that their entire records had to be dropped from the analysis.

Subjects.

The response rate was gratifyingly high. Of the 209 interviewers, 161 (over 75%) returned their filled-in self-report forms. Of those, 123 respondents (76%) requested individual data-analysis reports. Data from 153 or 95% of respondents (73% of the sought sample) were usable.

78% of respondents were female (the complete group of field interviewers showed a similar gender ratio). Ages ranged from 20 to 60+, peaking in the 40-49 age band. Interviewers were based throughout NZ. When respondents were split into subgroups according to geographical district, the demographics in each subgroup did not depart significantly from those of the overall group. This was also true when respondents were divided according to level of expertise. Nor did we find any evidence that respondents differed in any relevant way from non-respondents.

The level of participation was unusually high. Several reasons might have contributed to this. It may be that respondents saw the survey as a genuine attempt by Stats NZ to consult them, fostering a sense of good will – as well as self-interest, if they envisaged a possibility that the results of the survey could improve job conditions. Respondents were biased in favour of surveys and interviews, since their job consists of interviewing other people. The individualized analyses of responses were a factor, given the general appetite for self-knowledge and personal profiles. Finally, as another aspect of self-interest, respondents were paid for their participation.

Return to the salary-level variable mentioned earlier. We write Lq to label the level of the q-th respondent (Lq = 1, 2, 3 or 4). Essentially this is a record of promotion, so it is not purely measuring the respondent's level of job performance; Lq also increases with length of service. We are not too concerned with resolving these two intertwined qualities, since both are desirable from the viewpoint of recruitment and retention (a long period of service means that the initial job training was not wasted).

We also return to the distinction between CPI-survey and purely household interviewers. It is reasonable to look for a difference in each group's pattern of preferences – the aggregate 'occupational personality' – since the two roles do not entail identical tasks, as noted. For instance, CPI collectors work with more independence. Of the interviewers whose data were usable, 35 worked on the CPI survey. Approximately half of these were also household interviewers, so the distinction is not clear-cut.

Analysis:

Before trilemma data can be analyzed, they must be converted into a list of values v_{qi} (as before, q identifies the respondent while index i ranges across items). This entails relating the responses for each trilemma back to

Table 2 Items most positively and negatively associated with the respondent variable L_q.

Number	*r(i)*	Text of Item
76	0.180	Organising people
29	0.158	Seeing that others obey rules, laws and regulations
99	0.138	Getting others "back onto their feet"
74	0.128	Working by myself, alone
16	0.123	Providing others with legal advice
30	0.120	Helping others work out what they need to do
15	0.119	Working in sales
80	0.118	Following orders
77	0.117	Having responsibilities
54	0.112	Providing others with financial (money) advice
97	0.102	Doing it "my way'
31	0.094	Providing health care in medical settings
69	0.093	Teaching others
52	-0.158	Working with precious metals and gems
45	-0.142	Working with video and film
32	-0.139	Providing technical support for performers
1	-0.136	Working with technical manuals
42	-0.134	Working with ideas
51	-0.132	Working with current events or history
98	-0.121	Working with people known to my family
47	-0.115	Servicing heavy equipment
39	-0.113	Working with my hands
100	-0.108	Setting up a business
38	-0.104	Displaying products and materials
46	-0.097	Using computers
12	-0.084	Working in a trade e.g. florist, electrician, plumber, hairdresser etc.

its constituent items. If, for example, item i is picked as most- or least-preferred, it receives a score of +1 or - 1 respectively. v_{qi} is the average of these scores for the item, over the trilemmas in which it appears (this design involves two appearances of each item, but there could be fewer because of incomplete data).

In effect this process assigns each item a score on a five-point scale, comparable to rating-based responses. Since the two contexts in which each item is assessed differ from the contexts for comparison for other items, these scores are not completely commensurate from one item to the next, but any biases balance out when scores are aggregated in broad indices.

The items most positively and most negatively associated with Lq (salary level) are listed in Table 2. For each item in turn, $r(i)$ is the correlation – across all respondents - between Lq and the preference ratings v_{qi}. Values of $r(i)$ ranged from 0.18 down to 0.16. They paint a reasonably coherent picture: people who gain satisfaction from aiding clients and organizing their lives, tend to earn promotion as Field Interviewer. Their willingness to "work in sales" (item 15) does not necessarily indicate an interest in selling things *per se*, but rather, a degree of comfort with the human interactions involved in selling. There is also a sense that they enjoy working by themselves, but within a structured work environment. Conversely, the lower salary levels contain a greater proportion of people who enjoy the technicalities and minutiae of manual trades and crafts, and also those of office work.

The picture's coherence can be expressed in this way: there are significant correlations between $r(i)$, and the i-th item's coordinates within interest space. We performed a second-order multivariate regression using $r(i)$, rather than v_{qi}, as the dependent variable in Equation (1). The result fitted the pattern of correlations quite well (R = 0.59), and provided a vector $\mathbf{b}_L$ with components {-0.42, -0.28, 0.41}. That is, items tended to be associated with promotion as a field interviewer if they relate to People rather than Things, to Office rather than Physical activity (the weakest association), and to Routine rather than Creativity. These associations are plausible enough; in fact, they are little more than confirmations of common sense, though again they support the model's face validity. They may provide Stats NZ with some guidance for recruitment.

Figure 3 Example of the format used in individual analyses returned to respondents.

Interviewer Questionnaire **Statistics NZ / Massey University**

Individual Results for Informant 2

Please accept three limitations for these personalised results. First, they are based upon the information provided. Secondly, the computational procedures used to create them are still at the testing stage. And, finally, they are offered as a guide only and do not replace advice from professional vocational guidance personnel.

Your vocational preference responses are summarised on three broad scales (or dimensions):

D1: People	x_____0_____	Things
D2: Indoor (safety)	_____0_____x_____	Outdoor (adventure)
D3: Creativity	_____x_____0_____	Conformity

Briefly – your responses have favoured working with *people* rather than *things*; *creative* rather than *rule*-following forms of work; and *outdoor* (physical) rather than *indoor* work.

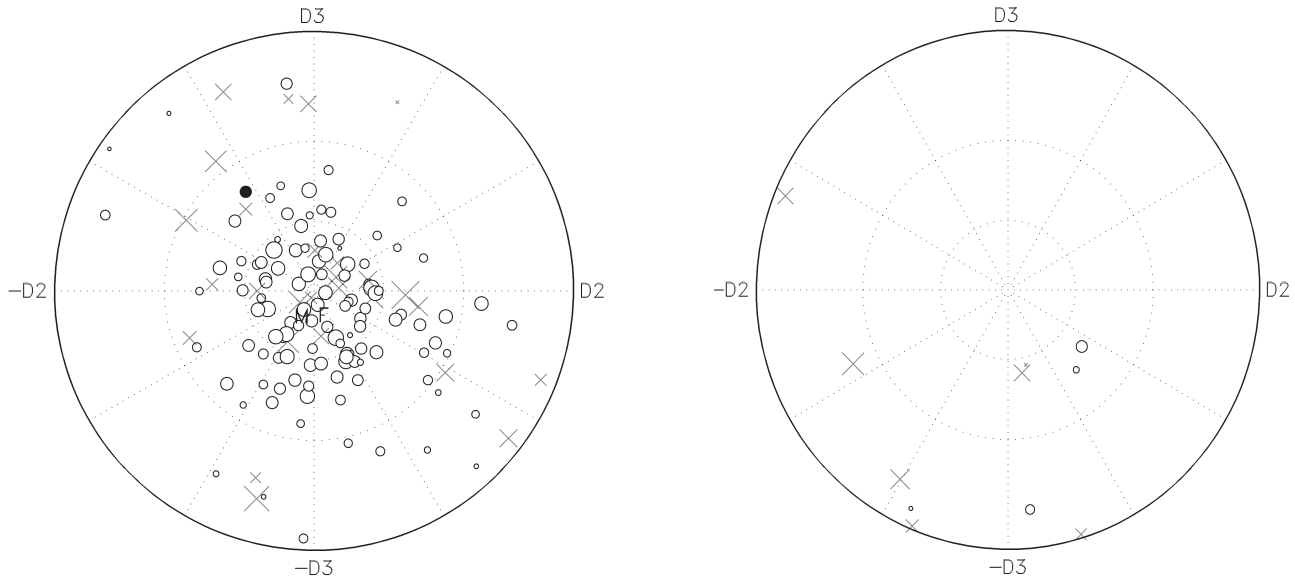
The CPI distinction could be characterized with a similar analysis. For each item, we calculated the difference between the mean of v_{qi} across CPI interviewers, and the mean across non-CPI interviewers. Let $\delta(i)$ represent these differences. T-tests revealed that individual $\delta(i)$ values approached but never passed the threshold of significance. However, when we examined the overall *distribution* of differences across the VOC-99 map, there was a small but significant negative correlation (p = 0.05) between $\delta(i)$ and x_{i2}. Recall that the second dimension distinguishes between office (cerebral) and outdoor (physical) aspects of work. In other words, CPI interviewers tended to assign relatively higher scores to items with 'office' connotations (compared to non-CPI respondents), and relatively lower scores to items with 'physical' connotations

We return now to individual responses. As explained in Study 1, Equation (1) provides a vector $\mathbf{b}_q$ to summarize each respondent's preference values v_{qi}. For the majority of respondents, the pattern of trilemma rankings was compatible with the three-dimensional model, and could be compressed into its Procrustean bed, losing fine distinctions in the process but retaining the global aspects of her or his vocational interests. The multivariate correlation Rq (indicating how well each $\mathbf{b}_q$ predicted or accounted for that respondent's v_{qi} values) was generally good, with a mean value of 0.52. However, Rq ranged down to 0.08: responses from a minority were *not* reducible to three-dimensional vector components.

These components were included as part of the individual analyses requested by many respondents. Figure 3 shows the format. The vectors are plotted in Figure 4, in the same stereographic projection as Figure 1. In this case both hemispheres are shown, as a pair of circles (which should be imagined as meeting along their circumferences), since a minority of vectors do have positive PT_q components (i.e. 'thing'-oriented preferences). But clearly there is a preponderance of people-oriented preferences.

Previous application of the VOC-99 to school-age subjects (Bimler & Kirkland, 2005, 2006) found a sex difference in this component of the vectors, with males and females tending to orient towards Things and People respectively. Further, school-age males and females tended to prefer outdoor / physical and indoor / cerebral activities respectively, though the tendencies

Figure 4 Vectors $\mathbf{b}_q$ within three-dimensional space, each summarising a respondent's self-descriptive ranking of the VOC-99 items. Vectors intersect a notional sphere; hemispheres are mapped separately onto circles as in Figure 1 (left and right circle represent the people- and thing-oriented halves of the space). Male and female respondents shown as crosses and circles respectively, with symbol size proportional to *Rq*. Averaging the rankings of males and females yields mean vectors shown as 'M' and 'F'. Solid circle represents the distribution of associations between items and "level"(summed as a direction $\mathbf{b}_L$).



were weak, with many exceptions. In contrast, the majority of males in the present sample provided people-oriented preferences, though there was still a significant difference between the mean of PT_q among females and males (0.12 and 0.06 respectively, $p < 0.001$). The present sample showed no significant sex difference in IO_q components. Until we study further vocational groups, we cannot tell whether differences were selected out by the recruitment process, or fade away with the maturation of older groups in general.

We calculated vectors to represent the *mean* male and female subject. These are included in Figure 4. The calculation involved averaging the individual item responses v_{qi} across each sub-population, to create descriptions of the average male and average female, which became the dependent variables in multivariate regression.

PT_m = -0.50, IO_m = -0.05, CR_m = -0.10, R_m = 0.46 and

PT_f = -0.84, IO_f = 0.07, CR_f = -0.16, R_f = 0.76.

The higher R_f indicates that females' mean scores are more compatible with the spatial model. This is also true at the individual level. It may be that males provided noisier data.

Extension – a pilot study of a computerized version.

We have conducted a pilot study of the practicality of the trilemma instrument as an adjunct to recruitment. Thirteen volunteers from the current Stats NZ staff acted out the role of an applicant for a position as Field Interviewer, and filled in a trilemma questionnaire as if it were part of an the interview.

In practice, Regional Field Supervisors would conduct such interviews. The ultimate intention is to have them enter the responses on their desktop computers, with data analysis carried out on a website for immediate feedback. In this simulation, however, the second author logged onto the website to enter the data, and forwarded the results to the volunteers.

It was intended that the instrument would take no more than 10 minutes to complete. Times ranged from five-and-a-half to 11 minutes, around a mean of seven-and-a-half. All respondents reported that the length of the questionnaire was acceptable, and not unduly long. Respondents were asked afterwards whether they would have responded differently to the trilemmas in an actual job interview. Many thought that they would have started out by trying to pick the 'right answers' sought by the interviewer, i.e. the responses which (they believed) would indicate the traits associated with 'Field-based household interviewer'. However, they also thought that this strategy would not last long, because the trilemma task already posed a sometimes difficult choice, which would have been made more difficult by any attempt at second-guessing. Indeed, this is one of the rationales for the trilemma format. Many reported that they encountered some difficult choices to make and then felt that they were contradicting themselves with their responses to subsequent questions.

Conclusions

First, note that the trilemma data collected in Study 2 are *ipsative*, because any increase in the score given to one item requires a decrease in the score for some other item. It has been argued that ipsative methods force subjects to make more informative choices, and facilitates comparisons between them, by eliminating the problem of 'response biases' (which include the possibility that a subject may tend to check many interests as Appealing, or tend to reject them just as indiscriminately). However, there are also concerns about ipsative data (e.g. Closs, 1996), and Bartram

(1996) has argued that response biases should be shown to be a genuine problem in a given situation, before choosing an ipsative over a normative (non-ipsative) instrument. In a recent survey of the issues, Meade (2004, p. 549) concludes that "measures of vocational interest seem ideally suited for ipsative measurement as the intent with these measures is to determine which career field may be most appropriate for each given respondent (rather than making predictions across respondents)." This hardly ends the debate, and comparisons across respondents still have their uses, including the testing of an instruments' validity (as a reviewer pointed out).

This report began with the working hypothesis that a reasonable match exists between the requirements (optimal traits) for an occupational role, and the average traits of people already employed in that role. As a corollary, the latter could serve as a surrogate for the former. This report's Study 2, of Field Interviewers, revealed the limits of the hypothesis. Self-descriptions of vocational preferences from people employed as field interviewers did not differ greatly from the average self-descriptions of a less selective sample (school-age subjects). This may reflect weak selection pressures during the recruitment process: we noted that Stats NZ was not always swamped by a plethora of candidates when it attempted to fill interviewer vacancies. In this case, the ideal or prototypic field interviewer can instead be characterized by *differences* between respondents who are more and less effective in the role.

We exploited the variations among subjects along a salary scale (L_q). The scores given by subjects to some items were positively correlated with L_q; for other items, the correlations $r(i)$ were negative. We used multivariate regression to summarize the overall pattern of these correlations as the vector $\mathbf{b}_L$. As a picture of the 'vocational personality' best suited for the occupation, $\mathbf{b}_L$ has a face-value plausibility. Support comes from the equally plausible results obtained from a similar analysis of the distinction between CPI and non-CPI interviewers,

In Study 1, the market-researcher subjects were asked directly to characterize the "Ideal Market Researcher" with their responses, so this additional processing was not necessary. The crucial point is that as practitioners, they had access to 'inside knowledge' about the requirements of their profession. However, their assessments must be qualified with an acknowledgement that descriptions provided by current representatives of a given occupation can be distorted by incumbent biases, such as the incentive to exaggerate its difficulty (Harvey, 1991; Morgenson & Campion, 1997). It would be interesting to present the subjects of Study 2 with a similar question, and ask them to rank the VOC-99 items according to the likelihood or desirability of encountering each interest in the "Ideal Field Interviewer".

Note that reduction to a direction in three-dimensional space is not the only way of summarizing the pattern of salary-level associations. The correlations $r(i)$ can equally well be summarized with any other scale which one might define for the VOC-99 inventory. The feedback provided to respondents used the three components of the vector $\mathbf{b}_q$ to summarize their data (i.e. along three bipolar scales). In addition, their data were also scored on 10 finer-grained empirical scales ("Trades, goods and services", "Artistic expression", "Guiding, mentoring", etc.), though that part of the feedback is not sufficiently relevant to cover in this report. The prototype market researcher in Study 1 was described on the same 10 scales.

It is intended to use the Trilemma instrument of Study 2 (Extension) as one of the components in a standardized recruiting procedure, to select new field interviewers. More specifically, this will provide another piece of background information about the potential field interviewer. The resulting 'style' graph could be compared to the baseline graph produced from the field interviewer project, and highlight any major differences between the two. However, there is no intention to use this tool in isolation from other recruitment documents and assessments – including a candidates' CV, the phone interview, the face-to-face interview, and any reference checks. Nor is there any desire to use the results for evaluating job performance. To repeat, convenience was the main factor behind choosing the VOC-99 as a research tool for exploring vocational style, and nothing in this study elevates it above other job-analysis instruments.

The end-user relevance of these data is that it provides selectors with additional knowledge when assessing potential candidates during recruiting. Stats NZ already uses a structured interviewing approach during interviewer recruitment, but the identification of common vocational styles will encourage us to re-examine the format of the interview and the questions asked of referees. Furthermore, the identification of common vocational styles will also provide those designing interviewer training with useful information about their audience. The information obtained could well alter both the content and presentation of interviewer training providing greater relevance for all participants.

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