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Gordon D. A. Brown
Jonathan Gardner
Andrew Oswald
Jing Qian

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Gordon D. A. Brown
University of Warwick

Jonathan Gardner
Watson Wyatt LLP

Andrew Oswald
University of Warwick and IZA Bonn

Jing Qian
University of Warwick

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IZA

P.O. Box 7240
53072 Bonn
Germany

Phone: +49-228-3894-0
Fax: +49-228-3894-180
Email: iza@iza.org

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ABSTRACT

Does Wage Rank Affect Employees' Wellbeing?*

What makes workers happy? Here we argue that pure 'rank' matters. It is currently believed that wellbeing is determined partly by an individual's absolute wage (say, 30,000 dollars a year) and partly by the individual's relative wage (say, 30,000 dollars compared to an average in the company or neighborhood of 25,000 dollars). Our evidence shows that this is inadequate. The paper demonstrates that range-frequency theory – a model developed independently within psychology and unknown to most economists – predicts that wellbeing is gained partly from the individual's ranked position of a wage within a comparison set (say, whether the individual is number 4 or 14 in the wage hierarchy of the company). We report an experimental study and an analysis of a survey of 16,000 employees' wage satisfaction ratings. We find evidence of rank-dependence in workers' pay satisfaction.

JEL Classification: J28, J30

Keywords: job satisfaction, wages, rank, wellbeing

Corresponding author:

Gordon D. A. Brown
Department of Psychology
University of Warwick
Coventry, CV4 7AL
United Kingdom
Email: G.D.A.Brown@warwick.ac.uk

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Rank Dependence in Employees' Wellbeing

I. Introduction

This paper examines the relationship between pay and wellbeing. We argue that pay satisfaction is influenced not only by the absolute level of pay, nor simply by relative pay. Instead, the skewness of wage distributions is important. An individual's wellbeing is determined partly by the rank-ordered position of their wage within a comparison set (e.g. whether they are the third most highly paid person in their organization, the twelfth most highly paid person, etc.).

Consider Professor X, a relatively successful member of a small university department. Professor X earns $20,000 more than the average wage of professors in the department, and only $10,000 less than the most highly paid faculty member in the department. In fact, Professor X is the third most highly paid member of the department. Compare the likely satisfaction of Professor X with that of Professor Y, a colleague in a different department and better paid discipline. Professor Y earns $10,000 more than Professor X, corresponding to $20,000 more than the average wage in Professor Y's department. Thus the salaries of Professor X and Professor Y are the same distance from the mean of their respective departments. Like her less well-paid colleague, Professor Y happens to earn just $10,000 less than the highest wage in her department. However, Professor Y is only the fifth most highly paid person in her department. Who will be more satisfied with their wage — Professor X or Professor Y?

Intuition and informal observation suggest that Professor Y may be less satisfied than Professor X, despite the fact that she is more highly paid and is identically located with respect with the mean and maximum departmental wages. To the extent this intuition is correct, it suggests that individuals care not just about their wage relative to some reference level, but also about the ranked position of their wage within their comparison set. This simple idea — one discussed theoretically by Layard (1980), Frank (1985a,b), and others — lies at the heart of the model that we test.

We extend a model originally developed in the literature on psychophysical judgment (Range Frequency Theory: Parducci, 1965; 1995). The model assumes rank-dependence — it suggests that satisfaction will be predicted partly by the ordinal position of a wage within a comparison set. In this paper that hypothesis is first tested in a laboratory-based experiment, in which the predictions of the rank-dependent model are confirmed. A more general model is developed, of which the rank-dependent model is a special case, and it is found that the rank-dependent model accounts for the data better than does a model based on accounts of the economics of inequity aversion. Our experimental study is followed by survey-based analyses of wage satisfaction ratings of 16,000 workers from approximately 900 workplaces. Those results also provide evidence, using a different methodology, for the importance of rank-dependence. Real-world satisfaction ratings are independently predicted by position in a wage ranking.

Models of Wage Satisfaction

The Neoclassical View and Reference Dependence. Neoclassical approaches to utility suggest that it will vary positively with the absolute wage level and negatively with the number of hours worked. Workers like income and dislike effort. This can be expressed as follows:

$$u = u(w_{abs}, h, i, j) \qquad (1)$$

where u is the utility gained from working, w_{abs} is the absolute level of income, h is hours of work, and there are additional parameters associated with characteristics of the individual worker (i) and the job (j). Much relevant work within psychology has also typically focussed on absolute, rather than relative, pay levels (e.g. the Pay Satisfaction Questionnaire: Heneman & Schwab, 1979, 1985; Judge & Welbourne, 1994).

However, recent years have seen the formulation of models intended to capture the intuition that *relative* wage will be an important determinant of utility. For example, Hamermesh (1975) argued that utility might be derived from obtaining wages greater than the average wage of an appropriate comparison group. Rees (1993) reviewed a number of informal arguments for the importance of relative wages in determining perceived fairness and wage satisfaction. Clark and Oswald (1996), using data collected from 5,000 UK workers, found evidence that utility depends partly on income relative to some reference or comparison income level. Groot and Van den Brink (1999) examined the pay satisfaction of heads of households within the Netherlands and also analysed data from the British Household Panel Survey. The authors found that pay satisfaction was determined by relative rather than absolute level of wages. Using panel data, Clark (2003) found that the impact of unemployment on wellbeing is subject to social comparison effects. A number of other studies have emphasized the importance of reference groups and comparisons in determining pay and job satisfactions (e.g. Bolton, 1991; Bolton & Ockenfels, 2000; Burchell & Yagil, 1997; Capelli & Chauvin, 1991; Capelli & Sherer, 1988; Dornstein, 1988; Finn & Lee, 1972; Goodman, 1974; Hamermesh, 2001; Hills, 1980; Law & Wong, 1998; Lawler, 1971; Martin, 1981; McBride, 2001; Oldham, Kulik, Stepina, & Ambrose, 1986; Patchen, 1961; Ronen, 1986; Taylor & Vest, 1992; Scholl, Cooper, & McKenna, 1987; Tremblay & Roussel, 2001; Tremblay, Sire, & Balkin, 2000; Ward & Sloane, 2000; Watson, Storey, Wynarczyk, Keasey, & Short, 1996). This may be expressed as follows:

$$u = u(w_{abs}, w_{mean}, h, i, j) \qquad (2)$$

where the additional term, w_{mean}, is a reference wage that will be negatively associated with utility. Comparison effects of the type embodied in Equation 2 and the studies listed above have long been a concern of the social sciences outside economics, most notably in studies of relative deprivation (Runciman, 1966). More recently, the suggestion that disutility may result from discrepancies between current state and desires or aspirations has been emphasized (e.g. Gilboa & Schmeidler, 2001; Solberg, Diener, Wirtz, & Lucas, 2002; Stutzer, 2004). At the interface between economics and psychology, the idea that losses and gains are assessed not in absolute terms but in terms of the change they represent from a reference point (such as the current state) has received wide currency in prospect theory (Kahneman & Tversky, 1979) and related accounts. The implications for economic models of a concern for relative wealth have received much attention (e.g. Blanchflower & Oswald, 2004; Bolton, 1991; Bolton & Ockenfels, 2000; Clark, 2000; Corneo, 2002; Corneo & Jeanne, 1997, 2001; de la Croix, 1998; Easterlin, 1995; Frey & Stutzer, 2002; Knell, 1999; Ok & Kockesen, 2000; for earlier research see e.g. Baxter, 1988; Boskin & Sheshinski, 1978; Duesenberry, 1949; Frank, 1985a,b; Hochman & Rogers, 1969; Konrad &

Lommerud, 1993; Kosicki, 1987; Layard, 1980; Lommerud, 1989; Oswald, 1983; Stark & Taylor, 1991; Van de Stadt, Kapteyn, & Van de Geer, 1985; Wood, 1978).

Rank Dependence. The models described above mostly though not exclusively assume that utility is derived from the comparison between an individual's wage and a single reference or comparison wage, typically the mean wage of a comparison group. Research has focussed on determining the reference group (e.g. Bygren, 2004; Dornstein, 1988, 1991; Law & Wong, 1998; Lawler, 1971, 1981; Martin, 1981). However, the intuition of rank dependence, introduced by the example of Professors X and Y above, suggests that more than one reference point may be used to determining wage satisfaction (cf. Folger, 1984; Kahneman, 1992) and hence that income rank effects may occur (see Easterlin, 1974; Frank, 1985a; Hopkins & Kornienko, 2004; Kapteyn, 1977; Kapteyn & Wansbeek, 1985; Kornienko, 2004; Robson, 1992; Van de Stadt, Kapteyn, & Van de Geer, 1985; Van Praag, 1968, 1971). A concern for rank-based status may have neurobiological underpinnings (Zizzo, 2002), and could serve an evolutionarily useful informational role (Samuelson, 2004; Samuelson & Swinkels, 2002).

Our attempt to develop a specific and psychologically motivated model of rank dependent wage satisfaction follows a substantial body of research concerned with effects of ranked position and inequality on health and well-being generally (e.g. Deaton, 2001; Marmot, 1994; Marmot & Bobak, 2000; Wilkinson, 1996); we discuss the relation between extant models of rank-dependence and inequality below. Although the issue of rank-dependence (as opposed to reference-group dependence) has received little direct empirical attention in the context of wage satisfaction, some existing results are consistent with a multiple-reference perspective. Ordonez, Connolly and Coughlan (2000) presented evidence that the judged satisfaction and fairness of a salary level was determined by separate comparisons of that salary to more than one referent (cf. also Highhouse, Brooks-Laber, Lin, & Spitzmueller, 2003; Seidl, Traub, & Morone, 2002; Taylor & Vest, 1992). Mellers (1982) examined how individuals chose to achieve "fairness" when they were given a sum of money to allocate between hypothetical members of a university faculty in the light of information about the different levels of merit and contribution of the faculty members. The results ruled out the notion that perceived fairness results when wages are allocated in proportion to contribution — showing instead that the whole distribution of contribution/merit ratings was seen as important in ensuring fairness. More specifically, perceived fairness results when the relative position of an individual's salary equates to their relative position on the merit/ contribution scale, with relative position being determined by RFT principles.

The concept of relative position is discussed more formally later when we outline the Range-Frequency model. Mellers (1986) extended the model to show that it also accounted for judgments of "fair" allocations of costs (taxes). Ratings of happiness both socially and intrapersonally are determined by the shape (skewness) of the distribution of events being rated (Smith, Diener, & Wedell, 1989), and social comparison effects of income on self-rated happiness are seen in an influence of the skewness of income distributions both within and between nations (Hagerty, 2000). The considerations reviewed above militate against the idea, assumed in most previous accounts, that a single reference point is used in making relative judgments.

If multiple reference points may be involved in determining wage satisfaction, the question of how the multiple comparators conspire to produce a single judgment must be addressed. Within the traditional economic literature, little attention is paid to the *distribution* of gains, losses, probabilities, or risks on the treatment of any individual loss, gain, or probability (although see e.g. Cox & Oaxaca, 1989; Lopes, 1987). We now introduce a potential approach to this problem, based on Range Frequency Theory (RFT: Parducci, 1995). Later we relate RFT to models of inequality aversion (Fehr & Schmidt, 1999) and note points of potential contact between RFT and recent developments in rank-dependent utility theory (Quiggin, 1993) and related developments in cumulative prospect theory (Tversky & Kahneman, 1992).

Towards a Model of Rank Dependent Wage Satisfaction

How exactly are judgments (in this case, judgments of wage satisfaction) made as a function of the context of judgment? Contextual effects on judgment have long been investigated (e.g. Parducci, 1965, 1968; 1974; 1995; Parducci & Perrett, 1971), and psychophysical models of contextual effects on judgment have begun to see application in economic and consumer psychology domains (e.g. Birnbaum, 1992; Brown & Qian, 2004; Hagerty, 2000; Mellers, Ordonez, & Birnbaum, 1992; Niedrich, Sharma, & Wedell, 2001; Smith et al., 1989; Stewart, Chater, Stott, & Reimers, 2003). Our work falls within this tradition of attempting to bring models of psychological processes to bear on economic questions.

The idea that judgments (e.g. of a wage) are made relative to a single reference point can be seen as rooted in Helson's (1964) Adaptation Level Theory. This assumed that judgments about simple perceptual magnitudes (such as weights, loudnesses, or brightnesses) may be made in relation to the weighted mean of contextual stimuli, or *adaptation level*.

The concept of adaptation level, though largely discredited within much of the psychophysical judgment literature from within which it originated, remains influential in social science. For example, within the consumer psychology and economic psychology literatures, accounts framed in terms of "reference prices" or "reference wages" are related to adaptation level theory, for such accounts typically assume that the attractiveness of the wage for a given individual, or a price for a product in a given category, will be determined partly by its relation to the mean wage or price for the given category. Such theories are in widespread use. While "reference point" and "adaptation-level" models assumed that judgments are made in relation to a mean of some kind, there is evidence in some domains that judgments are instead made with regard to the endpoints of a contextual distribution and/or the variance of the distribution (see Volkmann, 1951; Janiszewski & Lichtenstein, 1999; Stewart et al., 2003).

The trend from seeing magnitude perception and judgment as context-independent (analogously to the neoclassical assumptions embodied in Equation 1), through the suggestion that the mean of a contextual distribution is relevant (reference-wage accounts; Equation 2), to the idea that the variance of a distribution is also relevant, finds a natural extension in the observation that the *skewness* of a distribution can also be important. RFT captures this as follows. A central idea of RFT (Parducci, 1965; Parducci & Perrett, 1971) is that the ordinal position of an item within a ranked list of contextual items (a *comparison set*) will be important in determining judgment. It will matter over and above the position of the item with respect to the mean and variance of the distribution. Of course, for a given comparison set of items, the rank ordered position of an item within the set will be correlated with its absolute value, with its relation to the mean of the comparison set items, and with the item's location with respect to the lowest and highest values within the set. This complicates testing. Thus experimental results that have been interpreted as consistent with reference-wage accounts are not necessarily evidence against rank-dependent accounts. Despite the naturally high correlation between (e.g.) distance from mean and ranked position, such factors are distinct and can be distinguished experimentally. This is illustrated by the distributions in Figure 1. The items can be thought of as representing magnitudes along any psychological continuum (e.g. prices, wages, probabilities, weights, line lengths).

Consider X in Figure 1. How will the item marked X be perceived and how will its magnitude be judged? X has the same actual value in distribution A and distribution B. Furthermore, in each distribution, X is the same distance from the mean, the same distance from the mid-point, and the same distance from the end points. Nevertheless intuition, confirmed by empirical observation in a number of domains (e.g. Birnbaum, 1992; Mellers, Ordonez, & Birnbaum, 1992; Hagerty, 2000; Niedrich et al., 2001; Smith et al., 1989), suggests that human beings will judge the magnitude of X as lower in distribution A (where X is the second lowest stimulus) when compared with the judged magnitude of X in distribution B (where X is the fifth lowest stimulus). Analogous considerations apply, in reverse, for stimulus Y.

Effects of this type suggest that the ordinal value of an item within a contextual set will be relevant to its judged subjective magnitude. This assumption is incorporated into RFT.

Range Frequency Theory. RFT was initially designed to account for unidimensional stimuli such as weights, line lengths, or tones. The model (see Parducci, 1995, for a review) incorporates the empirical observations that the rating assigned to a given stimulus is determined both by its position within the range and its ordinal position in the ordered distribution of the stimuli.

This can be expressed as follows. Assume an ordered set of n contextual items:

$$\{x_1, x_2, \ldots . x_i, \ldots x_n\}$$

Then, if M_i is the subjective psychological magnitude of x_i, it is taken to be given by:

$$M_i = wR_i + (1 - w)F_i \qquad (3)$$

where R_i is the range value of stimulus i (x_i):

$$R_i = \frac{x_i - x_1}{x_n - x_1} \qquad (4)$$

and F_i is the frequency value, or ranked ordinal position of S_I, in the ordered set:

$$F_i = \frac{i - 1}{n - 1}. \qquad (5)$$

The subjective magnitude of a stimulus is thus assumed by RFT to be given by a convex combination of R and F. It is a convex combination of (a) the position of the stimulus along a line made up of the lowest and highest points in the set and (b) the rank ordered position of the stimulus with regard to the other contextual stimuli. (M_i is constrained to values between 0 and 1 in the formulation given above; if subjective magnitude estimates are given on, e.g., a 1 to 7 scale, then appropriate linear transformation is incorporated.) Here w is a weighting parameter which in physical judgments is often empirically estimated at approximately 0.5.

It is useful to note that RFT can be interpreted conservatively as a descriptive rather than a process account, and that it has generally, although not exclusively, been applied to tasks such as magnitude judgment or attractiveness ratings. Later, we develop a more general account (GSSM, for Generalised Similarity-Sampling Model) of which RFT is a special case.

Application of Range Frequency Theory to Wage Satisfaction. The RFT principles described above provide a simple and psychologically motivated framework within which intuitions about the rank-dependence of wage satisfaction can be expressed. More specifically, we hypothesize that feelings of satisfaction will be governed by the position of the rated wage within an ordered set of comparison wages and with respect to the highest and lowest values in the comparison set (see Seidl et al., 2002, for a related hypothesis). In other words:

$$u = u(w_{abs}, w_{mean}, w_{rank}, w_{range}, h, i, j) \qquad (6)$$

where w_{rank} and w_{range} are, respectively, defined for wages as in Equations 4 and 5. Hence Equation 6 nests the two approaches.

Note that w_{abs} and w_{mean} remain in the model. If RFT were to govern wage satisfaction ratings completely, w_{abs} and w_{mean} would have no influence on u. However, we leave them in the equation in order to test the complete model using the regression-based logic described below.

Interpretation

Before turning to new empirical evidence, we note that the account we offer attempts to link a psychophysical model to an economist's notion of utility. What reason is there to believe that a unified account might be possible?

Many paradigms that have been used to study economic choice and judgment essentially involve the assignment of numbers to represent psychological magnitudes, or a choice of actions based on the internal psychological magnitude associated with some state of affairs. Self-ratings of happiness or wage satisfaction exemplify straightforward cases where participants must provide numbers on a rating scale to indicate some aspect of their internal state. However, the judgment of the attractiveness of a particular market price, and/or the consequent decision whether to purchase product A or product B, will also be influenced by the position of the market price on an internal psychological "attractiveness" or "value" scale. Similarly, the choice of certainty equivalent (CE) for a particular gamble may depend upon the internal psychological magnitude of the riskiness of the gamble under consideration, and indeed the certainty equivalent (CE) assigned to a given gamble varies as a function of the range of CEs provided at decision time (Stewart et al., 2003) and the distribution (positively vs. negatively skewed) of options available at the time of choice is influential (e.g. Birnbaum, 1992). Brown and Qian (2004) argued that the inverse-S shaped probability weighting function of prospect theory could be explained by basic rank-dependent psychophysical principles. It seems reasonable to test the possibility that judgments of utility and satisfaction may conform to the same principles as psychological magnitude judgments more generally.

There is reason to believe that the principles embodied in RFT may be relevant to understanding the relation between wages and wellbeing. Smith, Diener, and Wedell (1989), in a laboratory-based study, found that RFT gave a fairly good account of both overall happiness ratings, and individual event ratings, when the happiness-giving events were drawn from positively and negatively skewed distributions. Hagerty (2000) concluded that, as predicted by RFT, mean happiness ratings were greater in communities where the income distributions were less positively skewed. Hagerty found that this effect held both within and across countries. In addition, Mellers (1982, 1986) found that RFT could give a coherent account of the judged fairness of wage distributions. Finally, Highhouse et al. (2003) found that salary expectations conformed to RFT principles, and Seidl et al. (2002) used RFT to model categorisation of incomes in a hypothetical currency.

Job and pay satisfaction ratings are more than mere noise. Wage satisfaction or job satisfaction measures are reliable over time (see Bradburn & Caplovitz, 1965) and correlate with measures of both mental and physical health (e.g. Palmore, 1969; Sales & House, 1971; Wall, Clegg, & Jackson, 1978). Satisfaction measures are systematic in that they can be predicted reliably. Furthermore, such measures predict behavior such as quit probability (Clark, 2001; Freeman, 1978; Shields & Ward, 2001).

In this paper, we present two tests of Range Frequency Theory. The first, a laboratory-based experiment, upholds the predictions of RFT in an artificial environment. The second uses survey data to generalise the conclusions.

II Investigation 1

Our first experiment, Investigation 1, used wage-satisfaction data, derived from a laboratory setting, to examine the explanatory ability of a model in which rank-dependence matters.

We asked undergraduates — a relatively homogeneous group — to rate how satisfied they would be with hypothetical wages that they might be offered for their first job after college. The key experimental manipulation was of the distribution of other hypothetical wages said to be offered to their classmates for similar jobs. In other words, the subjects' task was to rate satisfaction of a potential wage *in the context of* a set of other wages.

Six different wage distributions were used. There were 11 hypothetical wages in each distribution, and each participant was required to rate how satisfied they would be with each. The wage distributions are illustrated in Figure 2, while the actual wages used are listed in Table 1. The first two distributions (A and B; denoted *unimodal* and *bimodal* respectively) are designed to test the key prediction of rank-dependence, and follow the logic illustrated in Figure 1. Three wages are common to both distributions (excluding the lowest and highest wages); these are labelled A1 – A3 and B1 – B3.

Points A1 and B1 in Figure 2 are the same distance from their respective distribution means, and are also the same proportion up the range from lowest to highest in their respective distributions. Thus according to a simple reference-wage view, A1 and B1 would be given the same ratings, as would A2 and B2, and A3 and B3. According to rank-dependence, in contrast, A1 will be rated as less satisfying than will B1 (because A1 is the second lowest wage, while B2 is the 5th lowest). The reverse will be true for A3 and B3, while A2 and B2 should receive the same rating in both cases. Thus distributions A and B allow a clean test of for rank-dependence in which the effects of range and mean can be held constant.

The next two distributions in Figure 2, namely, C (*positive skew*) and D (*negative skew*), are included to test the ability of the model to account for the whole range of satisfaction ratings when the distribution is negatively (or, more realistically, positively) skewed. The distributions have two points in common. The fifth-highest wage in the negatively skewed distribution is the same as the second-highest wage in the positively skewed distribution, and the second-lowest wage in the negatively skewed distribution is the same as the fifth-lowest wage in the positively skewed distribution. However, any difference in satisfaction ratings is theoretically ambiguous because the relevant wages differ between the distributions in both ranked position and in distance from the mean. The final two distributions, E (*low range*) and F (*high range*), allow a pure test of the idea that position up the range is important in determining wage satisfaction. The critical sixth-lowest wage is the same in both distributions, and represents both the mean and the median in each distribution. However, in the low range condition the critical wage is 60% up the range from lowest to highest wage, while it is 40% up the range in the high range condition. Thus any difference in the satisfaction rating given to this critical wage will be unambiguous evidence for an effect of the position-within-range of a wage.

In summary, the collection of wage satisfaction ratings for the six distributions allows the predictions of rank-dependent, reference-dependent, and range-dependent accounts of wage satisfaction to be pitted against one another in a laboratory setting.

Method

Participants. Twenty-four first-year psychology students (17 women and 7 men, mean age=19.0 years) participated for course credit.

Materials. Six rating scales and 66 coloured labels were used in the experiment. Rating scales were 36 cm long and 4 cm wide strips of paper, on which a 7-point scale (34 cm long) was drawn in the centre of the strip. Each scale had seven equally spaced markers indicated (labelled 1-7). No other written information was present on the scale. Small labels were constructed to represent the wages to be rated. Annual wages were printed in a rectangular box on the labels, and the top of each label was made in the shape of a pointer that could be used to indicate the satisfaction rating of the hypothetical wage indicated on the label by placing the label's pointer at the appropriate place on the scale.

Design and Procedure. The experimental design was within-subjects, with six levels of annual wage distribution (as illustrated in Figure 2 and described above). Table 1 lists the actual wage values used in the experiment. A 6 x 6 Latin square design was used to counterbalance the presentation order of the distributions.

Participants were tested individually and given standard written instructions. The task was to state how satisfied they would be with each of 11 hypothetical annual starting salaries that they might be offered, given a context of the other 10 salaries being known to be offered to otherwise similar classmates. They were then given 11 labels, on each of which an annual salary was written. They were asked to imagine that these were starting salaries offered to similar graduates entering a similar occupation. They were then required to place the labels on a 7-point rating scale, with 1 corresponding to "least satisfied," and 7 to "most satisfied". After they finished their rating, the experimenter noted the positions the labels were placed in, and a new rating scale was provided to participants with a different set of labels corresponding to another distribution.

Results

Model-based Analysis. The results are shown in Figure 3, together with the fits of the model we describe below. We analysed the results in three ways. First, we examine the ability of the RFT model to fit the data, and then we carried out conventional statistical analysis to compare the satisfaction ratings given to wages common to different distributions. Finally, we embedded RFT within a more general framework and compared its performance with other extant models.

We took the RFT model (Equation 3) and obtained maximum likelihood parameter estimates using squared error minimisation. This is akin to fitting standard OLS of satisfaction responses on rank and range as covariates, but where the parameters are constrained to be *w* and *1-w*.

There is just one free parameter: the parameter *w* that specifies the weighting given to the ranking dimension relative to the range dimension. We adopt the conservative procedure of holding *w* constant for all six distributions; there was therefore a single value of one parameter to estimate for all 66 data points (11 in each of 6 distributions). The fit, from the pooled estimates, is shown as a solid line in each of the three figures (Figure 3a to 3c). The overall R^2 value obtained was .998, and the estimate of *w* was .36.

Model-comparison statistics confirmed the importance of both the range and the rank dimensions. We compared the goodness of fit of the model with and without the *w* parameter included (Borowiak, 1989). A restricted model in which only range influences ratings produced a significantly less good fit: (χ^2 (1)=241.9, $p<.001$) as did a restricted model in which only ranked position influenced satisfaction ratings: (χ^2 (1)=169.1, $p<.001$). The same conclusions obtained whether or not the resulting χ^2 values were adjusted using the Aikake procedure (Aikake, 1983) to take account of the additional parameter available in the version of the full model.

The analysis implicitly assumes that the psychological magnitudes of wages, prior to rating, are a linear function of actual wage amount. We also considered the possibility that a logarithmic or power-law transformation of the wage variables would improve the fit of the model. In neither case was there a significant increase in the explained variance.

Conventional Statistical Analysis. The differences in the mean rating of common points in comparative conditions were analysed using ANOVA.

There were three critical wage stimuli for the unimodal and bimodal distributions. They are the points labelled A1 through B3 in Figure 2. These points permit a test of the effect of rank when proportion up the range, and distance from the mean, are both held constant. An initial two-way ANOVA on the ratings given to the common points found, as expected, a main effect of point within distribution ($F(2,46)=809.17$; $p<.0001$); no main effect of distribution ($F(1,23)=0.60$; $p>.445$), and an interaction between them ($F(2,46)=124.68$; $p<.0001$). Post-hoc tests confirmed that the wage of £20.0K was rated as less satisfying when it was the second lowest wage than when it was the fifth lowest wage (t(23)=-8.034, p<.0001) and that the wage of £25.6K was rated as more satisfying when it was the second highest wage than when it was the fifth highest (t(23)=7.746, p<.0001).

In the comparison of positive-skew and negative skew conditions, £19.5K and £26.1K were the common salaries appearing in both conditions. The range difference between these points and the endpoints were the same in both conditions, but the positions in the rank orders were different. The salary £19.5K is the fifth lowest wage in the positive-skew condition but the second lowest in the negatively skewed condition. Conversely, £26.1K ranks second highest in the positive-skew condition but fifth highest in the negative-skew condition. As the means of the two distributions were not the same, the distances of the common points to the mean were also different. A 2 x 2 (common points X condition) ANOVA was used, and found the expected main effects of condition (ratings were higher in the positively skewed condition: F(1,23)=159.99; p<.0001) and point (ratings were higher for wages in the positive condition: F(1,23)=1860.02; p<.0001). The interaction was not significant (F(1,23)=1.0). A post-hoc test was conducted, and the results show that ratings were consistently higher in the positively skewed than in the negatively skewed condition for both the lower wage (t(23)=11.82, p<.0001), and the higher wage: (t(23)=11.09, p<.0001).

The single common point for the high-range and low-range conditions was examined in a similar fashion. Salary £22.8, which was the mean and the median of the distribution, has the same ranked position in both distributions, but different range values. A paired-sample t-test was used, and the analysis revealed, consistent with the predictions of RFT, that the effect of range was significant: t(23) = 2.435, p< .05 (two tailed). These results are consistent with those of Seidl et al. (2002) who, in a study that came to our notice after the present experiments were completed, found that RFT gave a good account of experimentally-obtained categorizations of incomes in a hypothetical currency.

Comparison with Models of Inequality Aversion. The RFT model, with an R^2 of .998, provides a good fit to the data. How well might other models do? One possibility is that extant models of inequality aversion and relative deprivation could be brought to bear on wage satisfaction. It has been argued that the notion of fairness needs to be incorporated into conceptions of utility (e.g. Fehr & Schmidt, 1999, 2001; Levine, 1998; Rabin, 1993). If wage satisfaction depends on perceived unfairness, then models of inequity perception could be applied to the present case. Given that RFT has already been shown to provide a good fit to "fair" allocations of salary increases and tax assignments (Mellers, 1982, 1986), the present data provide an opportunity to examine the different predictions of RFT and economic models of inequity as applied to wage satisfaction. Can economic models mirror the predictions of the psychologically-motivated RFT? We performed a direct comparison through development of a more general model.

Fehr and Schmidt (1999, 2001) develop a model of inequity aversion. In intuitive terms, the idea is that utility may be depend on (a) an absolute level of resource x_i, (b) the total weight of resources above x_i, and (c) the total weight of resources below x_i. More specifically, the utility function of individual i from n, earning x_i would be:

$$U_i(x) = x_i - \alpha_i \frac{1}{n-1} \sum_{j \neq i} \max\{x_j - x_i, 0\} - \beta_i \frac{1}{n-1} \sum_{j \neq i} \max\{x_i - x_j, 0\} \qquad (7)$$

The first term measures utility gained from absolute income, and the second and third terms measure utility reductions deriving from upward and downward inequality respectively (α and β assumed positive). The second term, when appropriately normalised, is closely akin to models of relative deprivation of the type that can be used to predict mortality risk (see Deaton, 2001) according to which relative deprivation is measured by the weight of the income distribution above a particular income (see also Kakwani, 1984; Yitzhaki, 1979).

Such an approach could be extended to the case of wage-derived utility. In comparing one's wage x_i with others, it seems reasonable to suppose that utility would be gained as a function of the weight of incomes below x_i, and lost as a function of the weight of incomes above x_i. Thus if the sign of the third term in (7) above is reversed, and α and β are both positive, the Fehr-Schmidt model can be extended to provide a potential model of comparison-based wage utility.

This version of Fehr-Schmidt model applied to wages, along with several models of relative deprivation, differs from RFT in that higher and lower earners are weighted more heavily as their distance from x_i in income-space increases. For the rank-based component of RFT, in contrast, only the *numbers* of higher and lower incomes within a comparison set matter. Both models contrast with an alternative model, developed below, in which incomes similar to x_i carry most weight in determining the utility associated with x_i. A further difference between the Fehr-Schmidt model and RFT is that only the former can accommodate individual differences in relative concern with upward and downward comparisons. Such differences exist. For example, Stutzer (2004) found that reduced wellbeing is observed for people with higher income aspiration levels when income and other individual characteristics are controlled for.

It is of some theoretical interest to show that the principles embodied in RFT, and those incorporated in the Fehr-Schmidt model, can be seen as special cases of a more general account. In intuitive terms, we can distinguish three different ways in which income-derived utility might be rank-dependent.

First, as in the Fehr-Schmidt model, higher and lower wages may be weighted by their difference from x_i. Such an approach receives support from the intuitive plausibility and empirical success of similar models of relative deprivation, as well as from considerations adduced by Fehr and Schmidt themselves.

Second, as in RFT, the mere relative rank of x_i may matter. Such an account derives plausibility from the success of RFT in accounting for "fair" allocations of wages and tax increases (Mellers, 1982, 1986); from the idea that only ordinal comparisons are psychologically possible or salient (see Kornienko, 2004; Stewart, Chater, & Brown, 2004); and from evolutionary considerations regarding sexual selection (the higher-ranking male of two will be chosen by a female irrespective of the distance separating them).

Third, and contrary to the Fehr-Schmidt approach, incomes relatively close to x_i may contribute more strongly than distant incomes in determining rank-dependent utility for x_i. This idea would be consistent with the considerable weight of evidence suggesting that social comparisons occur with generally similar agents (e.g. Festinger, 1954) and that pay referents tend to be similar (e.g. Law & Wong, 1998). Although in the economic environment occupational similarity will be correlated with proximity in wage space, experiments such as the one reported above allow wage similarity effects to be assessed in isolation.

We show that these three different approaches can be captured within a single framework as follows. First note that the rank component of RFT (equation 5) can be rewritten as:

$$F_i = 0.5 + \frac{(i-1)-(N-i)}{2(N-1)}$$

where F_i is the frequency value of wage x_i and N is the number of incomes in the ordered comparison set. Thus for a fixed comparison set F_i increases linearly with the number of higher incomes (N-i) and decreases linearly with the number of lower incomes (i-1).

A more general extension of RFT (equation 3) can then be written as follows:

$$U_i(x) = w_i.R_i + (1-w_i)\left[0.5 + \frac{\alpha_i \sum_{j=1}^{i-1}(x_i - x_j)^{\gamma} - \beta_i \sum_{j=i+1}^{N}(x_j - x_i)^{\gamma}}{2(\alpha_i \sum_{j=1}^{i-1}(x_i - x_j)^{\gamma} + \beta_i \sum_{j=i+1}^{N}(x_j - x_i)^{\gamma})}\right] \qquad (8)$$

where w_i is the weighting on the range component (cf. equation 3).

The three models outlined above can now be seen as special cases of (8), with particular values of γ corresponding to particular models. When $\gamma = 0$, and $\alpha_i = \beta_i = 1$, (8) reduces to range frequency theory — every higher and lower income contributes equally, independently of its distance from the to-be-judged wage, in influencing the overall judgment.

When $\gamma = 1$, the rank-dependent component of (8) shows behavior akin to the Fehr-Schmidt model: Comparison incomes diminish utility to the extent that they are greater than x_i and increase utility to the extent that they are less than x_i. The range-dependent component will mimic the absolute component in the Fehr-Schmidt model if appropriate anchor values are assumed.

When ⎣ < 0, the model behaves as a similarity-weighted model in which incomes close to x_i carry greater weight in the rank-dependent calculation. Finally, as ⎣ becomes > 1, increasingly high weight is given to incomes further away from x_i.

The behavior of the model is illustrated in more detail at the end of the paper. Here we fit the model to the behavior of participants in Experiment 1. In all model fitting we assumed a constant value of //, ▯, and ⎣, and fit the model to the mean data.

If ⎣ is set to zero, mimicking RFT but with //, ▯, and *w* allowed to vary, an R^2 value of .998 is obtained and the best-fitting estimates of //, ▯ and *w* are 1.03, 1.02, and .36 respectively. Thus the fit of RFT is not improved by allowing the relative weight given to higher and lower incomes to vary, and the estimates of // and ▯ are close to the values of 1.0 implicitly assumed by RFT.

We next set ⎣ to 1 to examine the behavior of the model derived from the Fehr-Schmidt approach. An overall R^2 of .941 was obtained, and the best-fitting estimates of //, ▯ and *w* were 0.91, 0.87, and .61 respectively. More importantly, when as here the same parameter estimates are used for all the different distributions of hypothetical wages, the Fehr-Schmidt approach cannot accommodate the key qualitative patterns in the data.

Finally we let ⎣ vary freely. This produced an R^2 of .998. ⎣ was estimated at 0.005 — very close to the value of zero implicitly assumed by RFT. Estimates of //, ▯ and *w* were 0.93, 0.91, and .36 respectively.[1]

The conclusion appears clear: RFT, with its assumption that only the *number* of higher and lower earners in a comparison set influences the rank-dependent component of utility, offers the best account of the present data. No extra variance is accounted for by a model, adapted from economic models of inequality aversion and

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[1] We also examined the behavior of a model in which the distances between wages prior to transformation by ⎣ was assumed to be given by their ratio rather than by the absolute difference between them. Such a model fits the data equally well, and has the advantage of consistency with the psychophysical literature in that an exponential similarity-distance function results under the Fechnerian assumption that psychological representations of economic quantities are logarithmically-transformed versions of actual stimulus values. Here however we maintain a focus on absolute differences to preserve comparability with the Fehr-Schmidt approach.

relative deprivation, according to which the total weight of incomes above or below a target wage influences comparison-based utility.

We do not, of course, claim that a similar conclusion would hold in all circumstances. In our experiment the comparison set is provided by design, whereas in real life similarity along a wage dimension will tend to be correlated with occupational similarity, and hence more similar wages will be more likely to enter into a comparison set. Individual differences may also be captured by any of the four parameters in (8) above. However the model allows us to represent various models, all currently available in the literature, in terms of a single more general model and hence may facilitate understanding of circumstances in which different weightings are given to different reference points.

For present purposes the key conclusion remains: Pure ranked position determines satisfaction with a hypothetical wage.

III Investigation 2

The generality of these laboratory-based findings is limited. Our satisfaction ratings were garnered with respect to hypothetical, rather than actual, wages. No information about the prospective jobs, other than wage levels, was provided. An explicit comparison set, provided by the experimenter, was given to participants and the methodology of the experiment implicitly encouraged the production of relative, rather than absolute, satisfaction ratings. It is therefore unclear how well the results would generalise to real-world settings. In keeping with our aim of adopting complementary methodologies, we designed a further study in an attempt to gain evidence for rank-dependence in wage satisfaction.

Investigation 2 tested the prediction of rank-dependence on a sample of approximately 16,000 workers in approximately 900 workplaces within the UK. To anticipate: this different methodology led to conclusions consistent with those of the laboratory-based experiment.

Method

We report here a number of analyses under the heading of Investigation 2. All used regression-based logic to estimate satisfaction equations. The aim was to determine whether the ranked position of an employee’s wage within the employing organisation would independently predict satisfaction measures when other measures were partialled out. Although much of the focus is on wage satisfaction, other satisfaction measures are also studied.

Data were taken from the Workplace Employee Relations Surveys (WERS). This UK-based survey has been conducted four times, originally in 1980 as the Workplace Industrial Relations Survey. Each survey is based on a representative sample of over 2,000 workplaces/establishments. The most recent survey was in 1997-1998 (WERS98); this was the first to include employee questionnaires and it is these that provide the data for the research reported here. All places of employment in Britain (including schools, shops, offices and factories) with ten or more employees were eligible to be sampled. WERS98 achieved participation from 2,191 workplaces, but 19 per cent of these refused to allow employee response to the worker questionnaire or agreed but ultimately did not provide responses. This left 1782 workplaces offering such survey responses. Some of these cases are eventually dropped in later regression analysis because of missing information on particular questions. Approximately 28,000 employees contributed completed questionnaires (a response rate of 64%); up to 25 employee questionnaires were distributed to randomly-selected employees within each organisation. The design of WERS98 is summarised in Cully (1998); initial findings from the study are described in Cully et al. (1998). The WERS98 data are available to researchers through the Data Archive of the Economic and Social Research Council (UK).

Employees were given self-completion questionnaires. They could return them either via the workplace or directly to the survey agency. Questions focussed on a range of issues including Employee Attitudes to Work, Payment Systems, Health & Safety, Worker Representation, and other related areas. The data of particular relevance to the current project concerned wage measures and job satisfaction measures. The dependent variables we used were four measures of satisfaction, as listed below. The WERS98 "Employee Questionnaire" included a question (A10) phrased as follows: "*How satisfied are you with the following aspects of your job?*" Four aspects were listed: "*The amount of influence you have over your job*"; "*The amount of pay you receive*"; "*The sense of achievement you get from your work*", and "*The respect you get from supervisors/line managers*". In each case one box representing a position on a five-point scale was ticked; the box labels ranged from 1 (Very Satisfied) to 5 (Very Dissatisfied). A sixth "Don't Know" option was also available. These satisfaction measures were the predicted variables in the following analyses, but for numerical ease of interpretation the scaling here is reversed (so that 5 represents the highest level of satisfaction).

We divide the independent variables into wage-related variables (those of interest to the present hypotheses) and background variables (those that were included in the regression equation to partial out the effects of the relevant factors). Background variables are listed in Table 2. The pay variables we used as predictors of wellbeing were as follows.

1. w_{abs}. Weekly pay of individual $\underline{i}$
2. w_{mean}. Average pay of workplace $\underline{j}$
3. w_{rank}. Rank of individual $\underline{i}$ in workplace $\underline{j}$ as proportion of number of workers, where greater rank indicates the worker is higher up the pay scale. This was calculated as ($rank_{\underline{ij}}$ - 1)/(number of observations $workplace_{\underline{j}}$ - 1)
4. w_{range}. The distance the individual worker is up the range of $pay_{\underline{i}}$ in workplace $\underline{j}$. This was calculated as a proportion as $(pay_{\underline{i}} - pay_{\underline{j}}^{min})/(pay_{\underline{j}}^{max} - pay_{\underline{j}}^{min})$.

w_{abs} and w_{mean} were logarithmically transformed prior to analysis in all cases except where noted. These measures were expected to be highly correlated. The crucial measure for the rank-dependent hypothesis is w_{rank}. If the predictions of our model hold true for the satisfaction ratings of employees in the workplace, we would expect the w_{rank} and the w_{range} measure to predict self-reported levels of pay satisfaction even when the effects of other variables are partialled out statistically.

Results

Initial analyses were carried out on data collected from all workplaces with at least 15 employee-pay observations. The resulting sample contained 16,266 individuals from 886 separate workplaces.

The correlations between the main variables of interest are shown in Table 3. The wage measures are highly intercorrelated, with w_{abs} (log transformed) having a correlation greater than .6 with all of w_{rank}, w_{range}, and w_{mean} (log transformed). Of relevance to the hypothesis of rank-dependence is the fact that w_{rank} was more highly correlated with pay satisfaction than was any other pay measure.

Ordered probit analyses were undertaken. The background measures listed in Table 2 were always included. We do not report the coefficients for these variables.

All columns in the regression results tables reported below were estimated by the Ordered Probit technique. Standard errors are in parentheses and are robust to arbitrary heteroscedasticity and clustering bias. The Pseudo R^2 values were calculated using the McKelvey-Zavoina method. Pay measures were log transformed in all cases, although each analysis was also repeated with untransformed measures and similar results were obtained.

An initial analysis examined whether the effect of absolute pay level on satisfaction measures was similar in the restricted sample of organisations that we used compared with the complete sample (N=1747).

Table 4a shows the results for the complete sample; Table 4b gives the results for the restricted sample. In both the full and the restricted sample, w_{abs} is a significant independent predictor of each satisfaction measure when the effects of the background variables are partialled out. The coefficients were similar in both samples. This preliminary analysis provided some reassurance that the restricted sample was representative; subsequent analyses focussed on the restricted samples alone as it was deemed necessary to have a sufficient number of data points for each organisation (at least 15) for analysis of w_{range} and w_{rank} variables to be interpretable.

The result of adding w_{mean} into the equation is shown in Table 5. w_{mean} accounted for no significant additional variance in pay satisfaction, while absolute pay level remained a significant predictor of wellbeing. For the other satisfaction measures, w_{mean} was a small negative predictor of satisfaction. Next, the w_{rank} and w_{range} measures were added into the equation, and the results are shown in Table 6a. w_{rank} had a clear independent effect, consistent with the rank-dependent hypothesis under test. The results should perhaps be interpreted with some caution due to the intercorrelation between variables (particularly w_{rank} and w_{range}: r=.8). The coefficient for w_{mean} was, unexpectedly, positive.[2] The other three satisfaction measures were, as before, not predicted by w_{mean}. One possible interpretation of the positive mean-wage finding is that workers view themselves as having better promotion and financial prospects in a highly-paid workplace.

Due to the intercorrelations among the pay variables, further analyses were carried out in which the only predictors were w_{abs} and either w_{rank} (Table 6b) or w_{range}

[2] This effect was smaller in the analysis in which pay values were not logarithmically transformed.

(Table 6b). In these, both w_{rank} and w_{range} accounted for significant additional variance beyond that accounted for by w_{abs} and the background variables.

In summary, satisfaction in this sample of over 16,000 employees from almost 900 separate organisations was predicted by (a) the individual's absolute level of pay, (b) the individual's ranked position of pay within the organisation, and (c) the individual's position along the pay band, namely, where the individual lay between the lowest and highest pay levels in the organization.

The analyses above have implicitly assumed that all salaries in an organisation are relevant to determination of a rank-dependent satisfaction rating. An alternative possibility is that the comparison set is assessed by occupational similarity. To return to the example of Professors X and Y with which we opened the paper, intuition suggests that Professor X's wage satisfaction will be determined primarily by the ranked position of X's wage with respect to that of other academic professors within the department, and less by the ranked position of the wage with respect to other (less occupationally similar) employees within the institution such as the Dean, the President, or clerical staff.

More generally, one might hypothesise that two processes are involved in determination of wage satisfaction. The first process involves selection of a comparison or contextual set containing multiple salaries, while the second process involves arrival at an overt satisfaction rating on the basis of the items within the comparison set. The present paper addresses primarily the second process, but it is likely that the first process (selection of a comparison set) involves some kind of similarity-based sampling. For example, one might include in one's comparison set people of similar age and wage to oneself, those of people in similar occupations, and those who are geographically close (Bygren, 2004; Festinger, 1954; Goethals & Darley, 1977; Law & Wong, 1998; Martin, 1981; Scholl, Cooper, & McKenna, 1987). For example, according to Kahneman and Miller's (1986) Norm Theory, a stimulus or event is judged and interpreted in the context of an evoked set of relevant stimuli or events that are retrieved (often due to their similarity) by the event to be judged. There is ample evidence that human memory works in a way that would lead to formation of such a comparison set (e.g. Brown, Neath, & Chater, 2002; Hintzman, 1986; Nosofsky, 1986).

The full complexities of such processes fall outside the scope of the present study. However, we were able to address the issue in a small way, by examining a subset of the WERS98 data taking into account occupation (using the Occupational Group code collected as part of WERS98). More specifically, we examined the satisfaction ratings from employees as a function of the range and rank of their wage in relation to other employees from the same occupational category.

We used the regression approach as described above to predict satisfaction ratings from employees in terms of the wages of other employees in the same organisation and the same occupational group. We confined analysis to the largest occupational group within an organisation, and used only cases where there were at least 10 employee observations in the largest occupation. This reduced the sample size to 4744 individuals from 373 separate workplaces.

The results were essentially identical to those obtained in the larger analyses on groups not differentiated by occupation, although the effect of w_{range} was weaker or absent. We report only the final analyses – those that examine, separately, the effects of w_{rank} and of w_{range} when the effects of w_{abs}, as well as the effects of all other background measures, are partialled out statistically. The results of these analyses are shown in Tables 7a and 7b. It is evident that wage satisfaction, as well as most other satisfaction measures, is independently predicted by w_{rank}. However, w_{range} did not independently predict pay satisfaction, although it did predict other satisfaction measures.

Other analyses produced similar results to the more inclusive analyses, with some minor exceptions as follows. First, w_{rank}, but not w_{range}, contributed independent variance in the combined analysis in which w_{abs}, w_{mean}, w_{rank}, and w_{range} were all included. (In the equivalent analysis for the larger sample, reported in Table 6a, both w_{rank} and w_{range} were independently significant.) Second, in the same combined analysis, the positive coefficient linking w_{mean} to pay satisfaction was not statistically significant in the analysis of untransformed variables.

This further analysis in which only same-occupation wages were assumed to enter into the calculation of range-dependent wage satisfaction led to conclusions consistent with the key hypothesis of rank-dependence: w_{rank} influences wage satisfaction over and above actual wage (w_{abs}). We note that the observation of an independent effect of w_{rank} is evidence against two potential objections to our interpretation. The first is that the measures we have adopted (e.g. of w_{rank} and w_{range}) contain too much error to permit theoretical inference. The second is that, because workers can move and choose their locality, in equilibrium there should be no relationship between satisfaction and rank. Both of these objections predict no observed correlation.

In summary, the survey-based study produced results consistent with the hypothesis that an individual gains utility from the ranked position of his or her wage within a comparison set. The absolute level of pay and the distance of his or her wage from a "reference" wage also both matter. It appears that theoretical leverage can be gained by importing theories of judgment derived from psychophysics into economic theory. The same cognitive principles may govern the way in which judgments are affected by context in different domains.

IV Overview Remarks

Our central finding is the importance of rank-dependence in pay satisfaction and workers' wellbeing. The implications seem wide.

We note that the rank-dependent approach offers the possibility of accounting for otherwise puzzling phenomena. For example, consider an experiment varying the distribution of rewards. In condition 1, subjects receive 50p on a random 90% of trials and 20p on the remaining 10% of trials. In condition 2, subjects receive 50p on a random 90% of trials (just as in the first condition) but on the remaining 10% of trials they receive 80p. Empirical observation (Parducci, 1968, 1995) suggests that subjects in the first condition might rate themselves as more content at the end of the experiment than will participants in the second condition, even though the total amount of money they have received, and the average earnings per trial, are lower. RFT offers a straightforward account of findings such as this – intuitively, the idea is that in the first condition the participants are most of the time being rewarded at the upper end of their expectations. This will lead to greater satisfaction (see Parducci, 1968, 1995). Other phenomena would require extension of the model presented here to allow for the fact that recent exemplars (e.g. wages) are more likely to be included in a comparison set and hence contribute to RFT-determined satisfaction ratings. For example, recent payments contribute more to satisfaction (e.g. Kahneman, 1999), suggesting that an overall judgment is based on a recency-biased sum of individual judgments.

The findings are consistent with a large body of evidence demonstrating the importance of relativities in determining pay adjustments and productivity, underlining the need to develop a full theoretical understanding of the relevant psychological mechanisms. For example, Levine (1993) surveyed compensation executives and found that pay adjustments, while weakly related to factors such as prevailing unemployment and quit levels, strongly preserved relativities within occupational categories. Real-world consequences, e.g. for productivity, can result from perceived pay inequity (e.g. Cowherd & Levine, 1992). Wage variance may relate to effort and perceived variance-related inequity may lead to wage compression (Akerlof & Yellen, 1990, 2001), further highlighting the practical importance of understanding distributional effects on pay satisfaction. More generally, the importance of fairness and inequity aversion in understanding a wide range of economic behavior (Fehr & Schmidt, 1999, 2001) points to the need for a psychologically plausible model of fairness and its relation to wage satisfaction (Mellers, 1986).

An additional issue concerns the relation between utility and income. A rank-dependent component of utility, combined with a positively-skewed distribution of incomes or resources, will lead rather naturally to a utility function that is concave-downward for most of its range (as in the results of Investigation 1). At higher and higher incomes, it becomes steadily harder to buy rank (see Kapteyn & Wansbeek, 1985; Seidl et al., 2002; Stewart et al., 2004; van Praag, 1968; for related accounts; Seidl, 1994, for a critical discussion).

Thus the approach developed here potentially offers independent psychological motivation for a theory of diminishing marginal utility (see also Kornienko, 2004, and references therein). As an example, consider the case when the majority of incomes within a community are relatively low with respect to the overall range of incomes in that community, as in the normally-observed case of positively skewed incomes. Under such circumstances a given absolute increase in a relatively low income will lead to greater progress up the rank ordered set of incomes than will the same increase when applied to a relatively high income. Given the tendency for large amounts to be rarer than small amounts, both for economic quantities such as incomes, assets, or financial settlements, and in the natural world more generally (Zipf's Law; see e.g., Bak, 1997; Chater & Brown, 1999; Schroeder, 1991; Stewart et al., 2004) it may be that rank-dependence may be one factor underlying the typically-observed concavity of utility functions and that such concavity may be mutable as a function of resource distribution. The concavity of the function will decrease (and change from a cumulative probability function to a straight line) to the extent that utility depends on absolute income in addition to ranked position, and will increase with amount of positive skew in community resource distribution and transition to convexity if resources follow a negatively skewed distribution. Indeed, Investigation 1 found evidence consistent with convex utility in a context of negatively skewed incomes.

However the relation between underlying resource distributions and the resulting rank-influenced utility curves will depend in subtle ways on the model of rank dependence. This is illustrated in Figure 4. Figure 4a shows the positively skewed income distribution of a hypothetical community, and the remaining panels show the function relating utility to income that would obtain in that community if utility was rank-dependent in the ways described by the general model introduced above (equation 8). Parameter w was set to 0 in all cases. Panel b shows the wage utility curve when $\alpha = 1$; $\beta = 1$, and $\gamma = 0$ (RFT). This is just the cumulative probability distribution. Remaining panels show the influence of varying other parameters. Panel c shows the effect of varying γ when $\alpha = \beta = 1$. From left to right, curves reflect γ values of -.5, 0, 0.5, 1, 2, and 3. Traditional concave utility functions emerge for values of γ close to zero, consistent with RFT. Panel d shows the effect of holding γ constant (at 1.0, as implied by relative deprivation-based models) and emphasising relative utility gained from focussing solely on the weight of income above the income to be evaluated ($\alpha = 0$, $\beta = 1$, concave utility) or gained from focussing solely on the weight of income below ($\alpha = 1$, $\beta = 0$, convex utility).

It is evident, then, that plausible utility curves can result from a variety of rank-based comparison processes, given a positively-skewed wage distribution. Detailed calibration of such models will require evidence on individual differences in upward-looking vs. downward-looking focus (e.g. Stutzer, 2004).

The perspective we have presented, although derived from psychology, has some points of similarity with rank-dependent accounts developed in within economics and at the interface between economics and psychology. As we noted in the introduction, influential accounts of decision making, such as prospect theory (Kahneman & Tversky, 1979), rely on the notion of a single reference point in relation to which outcomes are assessed as gains or as losses. The reference point may be seen as current endowment or as customary consumption (see e.g. Munro & Sugden, 2003, for discussion and an alternative reference-point model). Lim (1995) suggests that RFT principles can be used to derive a single reference point. Such accounts contrast with RFT's emphasis on multiple reference points.

However, the class of rank/sign dependent utility theories (RDSU) (e.g. Quiggin, 1982; Schmeidler, 1989) and the rank-dependent extension of prospect theory (cumulative prospect theory: Tversky & Kahneman, 1992) incorporate rank-dependence into the assessment of lotteries (see Diecidue & Wakker, 2001, for an intuitive justification). They therefore allow that differential weighting may be attached to outcomes as a function of the relative rank of the attractiveness of such outcomes. More specifically, RDSU accounts frame outcomes within a lottery in terms of cumulative probabilities, and weighting may thus given to the probability of doing "at least as well as" or "at least as badly as" some outcome. Individual differences (such as pessimism and optimism) may thereby be incorporated into such accounts (Weber & Kirsner, 1997). The notion of aspiration level forms an additional component of the SP/A theory (Lopes, 1987; see Lopes & Oden, 1999, for a discussion of the relation between cumulative prospect theory and SP/A theory).

Thus developments in RDU are related to the account we have developed here in terms of their emphasis on rank-dependence as a particular type of context-dependence. Yet the area of application of RSDU (lottery evaluation) is different from the present application of RFT, and there is no straightforward way to extend the machinery of rank-dependent utility to cases like wage satisfaction. The concern in modelling wage satisfaction case is with the evaluation of a single outcome, rather than with a set of outcomes, and weighting is of outcomes rather than cumulative probabilities. Moreover, a fundamental difference between rank-dependence in RFT and in RDSU theories relates to the notion of *coalescing*. In the case of complex lotteries, coalescing is the idea that common outcomes can be amalgamated — two probabilities of a given gain can be coalesced into a single larger probability of the same gain. Original prospect theory included editing rules to allow this (Kahneman &

Tversky, 1979) but coalescing is implicit in rank-dependent utility theories (see e.g. Birnbaum & Navarrete, 1998; Birnbaum, Patton, & Lott, 1999). However there can, contrary to the assumption of coalescing, be effects of event-splitting (Humphrey, 1995; Starmer & Sugden, 1993). Birnbaum and his colleagues have argued that RDSU models as a general class are problematic in that they fail to allow violations of stochastic dominance, yet such violations can be reliably observed. Configural weighting theory, in contrast, (Birnbaum, 1973, 1974) which assigns rank-dependent weightings to events but allows violations of stochastic dominance, appears do a better job of accounting for the data; Birnbaum et al. (1999) highlight the role of coalescing in particular. It is important to note, therefore, that RFT, like configural weighting theory, allows violations of coalescing – if an event with a given probability is split into two events of lower probability, then the ordered position (and hence evaluation) of more favourable outcomes would be expected to change. There are thus several differences between the perspectives of RFT and of RDSU. Further work is needed to achieve a reconciliation.

V Conclusion

This paper argues that economists' textbook models are too simple. Workers do not care solely about their absolute level of pay, nor are they concerned solely with their income relative to the average remuneration around them. To understand what makes workers satisfied it is necessary to look at the distribution of wages inside a workplace.

We show that rank matters to people. They care about where their remuneration lies within the hierarchy of rewards in their office or factory. They want, in itself, to be high up the pay ordering.

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Table 1. Annual Wages Used in Six Distributions in Investigation 1

Pos skew	17.2	17.6	18.1	18.7	19.5	20.3	21.4	22.7	24.3	26.1	28.4
Neg skew	17.2	19.5	21.3	22.9	24.2	25.3	26.1	26.9	27.5	28.0	28.4
Unimodal	17.2	20.0	21.5	22.2	22.6	22.8	23.0	23.4	24.1	25.6	28.4
Bimodal	17.2	17.4	17.8	18.5	20.0	22.8	25.6	27.1	27.8	28.2	28.4
Low Range	14.3	17.1	18.6	20.0	21.4	22.8	25.9	26.8	27.5	28.0	28.4
High Range	17.2	17.6	18.1	18.8	19.7	22.8	24.2	25.6	27.1	28.5	31.3

Note: 17.2 means a value of £17,200 pounds sterling

Table 2: Background Measures Included as Variables in All Regressions

Measure
Age
Employer size
Temporary job
Education
Gender
Race
Union recognition
Occupation (SOC Code at the one-digit level)
Industry (SIC code at the two-digit level)
Region
Hours worked
Marital status

Table 3

Correlation matrix (no sample weights) among the following variables: Employee's Satisfaction with Influence over the Job; Satisfaction with Pay; Satisfaction with Achievement; Satisfaction with Supervisors' Respect; Log of Pay; Log of Mean Pay; the Rank measure of Pay; the Range measure of Pay.

14703 observations

	Influence	*Pay*	*Achievement*	*Respect*	*Ln(pay)*	*Ln(mpay)*	*Rank*	*Ran*
Influence	1.000							
Pay	0.339	1.000						
Achievement	0.523	0.312	1.000					
Respect	0.523	0.348	0.499	1.000				
Ln(pay)	0.041	0.083	0.021	-0.021	1.000			
Ln(mpay)	0.005	0.062	-0.021	-0.030	0.680	1.000		
Rank	0.095	0.119	0.086	0.046	0.643	0.042	1.000	
Range*	0.072	0.116	0.072	0.024	0.673	0.134	0.801	1.0

* 'Range' means the worker's distance along the range of wages being paid in the workplace.

Correlation matrix (sample weights)

14703 observations

	Influence	*Pay*	*Achievement*	*Respect*	*Ln(pay)*	*Ln(mpay)*	*Rank*	*Ran*
Influence	1.000							
Pay	0.337	1.000						
Achievement	0.532	0.309	1.000					
Respect	0.538	0.347	0.514	1.000				
Ln(pay)	0.027	0.062	0.009	-0.046	1.000			
Ln(mpay)	-0.005	0.058	-0.030	-0.060	0.698	1.000		
Rank	0.090	0.089	0.090	0.052	0.636	0.072	1.000	
Range	0.070	0.092	0.081	0.030	0.653	0.142	0.792	1.0

Table 4a. Satisfaction Equations (in four domains) with Absolute Pay as an Independent Variable. Standard errors in parentheses.

Regressor	*Influence*	*Pay*	*Achieve*	*Respect*
Ln(pay)	0.128	0.556	0.119	0.057
	(0.021)	(0.026)	(0.021)	(0.022)
Observations				
Workplaces	1744	1744	1744	1744
Individuals	21862	21862	21862	21862
Log-L	-28167.4	-30237.5	-28294.2	-30508.6
Pseudo R^2	0.065	0.116	0.086	0.063

Table 4b.

Regressor	Influence	Pay	Achieve	Respect
Ln(pay)	0.144	0.577	0.127	0.084
	(0.026)	(0.034)	(0.026)	(0.028)
Observations				
Workplaces	897	897	897	897
Individuals	14703	14703	14703	14703
Log-L	-18830.8	-20229.4	-18943.2	-20351.7
Pseudo R^2	0.070	0.127	0.090	0.064

Table 5. Satisfaction Equations (in four domains) with Pay and Mean Pay as Independent Variables.

Regressor	Influence	Pay	Achieve	Respect
Ln(pay)	0.171	0.554	0.159	0.115
	(0.026)	(0.033)	(0.027)	(0.029)
Ln(mean pay)	-0.092	0.077	-0.108	-0.105
	(0.035)	(0.041)	(0.034)	(0.038)
Observations				
Workplaces	897	897	897	897
Individuals	14703	14703	14703	14703
Log-L	-18826.2	-20226.1	-18936.9	-20345.7
Pseudo R^2	0.071	0.127	0.091	0.065

Table 6a. Satisfaction Equations (in four domains) with Pay, Mean Pay, Rank and Range as Independent Variables.

Regressor	Influence	Pay	Achieve	Respect
Ln(pay)	-0.013	0.297	0.047	0.010
	(0.040)	(0.048)	(0.040)	(0.042)
Ln(mean pay)	0.086	0.319	-0.000	0.000
	(0.046)	(0.059)	(0.046)	(0.050)
Rank	0.359	0.356	0.215	0.256
	(0.062)	(0.071)	(0.066)	(0.066)
Range	0.065	0.244	0.041	-0.015
	(0.063)	(0.069)	(0.064)	(0.064)
Observations				
Workplaces	897	897	897	897
Individuals	14703	14703	14703	14703
Log-L	-18803.1	-20185.7	-18928.6	-20335.9
Pseudo R^2	0.074	0.133	0.093	0.067

Table 6b. Satisfaction Equations (in four domains) with Pay and Rank as Independent Variables

Regressor	Influence	Pay	Achieve	Respect
Ln(pay)	0.047	0.517	0.053	0.008
	(0.032)	(0.039)	(0.031)	(0.032)
Rank	0.316	0.196	0.238	0.247
	(0.048)	(0.051)	(0.048)	(0.050)
Observations				
Workplaces	897	897	897	897
Individuals	14703	14703	14703	14703
Log-L	-18805.6	-20219.5	-18928.9	-20336.0
Pseudo R^2	0.074	0.128	0.093	0.067

Table 6c. Satisfaction Equations (in four domains) with Pay and Range as Independent Variables

Regressor	Influence	Pay	Achieve	Respect
Ln(pay)	0.081	0.516	0.075	0.044
	(0.031)	(0.039)	(0.031)	(0.032)
Range	0.198	0.191	0.161	0.127
	(0.048)	(0.054)	(0.050)	(0.050)
Observations				
Workplaces	897	897	897	897
Individuals	14703	14703	14703	14703
Log-L	-18821.0	-20220.0	-18936.7	-20347.5
Pseudo R^2	0.072	0.128	0.091	0.065

Table 7a.

Satisfaction Equations (in four domains) with Pay and Rank as Independent Variables; comparisons are within occupational group.

Regressor	Influence	Pay	Achieve	Respect
Ln(pay)	-0.033	0.306	-0.036	-0.027
	(0.062)	(0.076)	(0.063)	(0.073)
Rank	0.358	0.194	0.297	0.327
	(0.078)	(0.087)	(0.081)	(0.080)
Observations				
Workplaces	366	366	366	366
Individuals	4249	4249	4249	4249
Log-L	-5505.8	-5784.3	-5550.2	-5869.7
Pseudo R^2	0.070	0.143	0.127	0.086

Table 7b.

Satisfaction Equations (in four domains) with Pay and Range as Independent Variables; comparisons are within occupational group.

Regressor	Influence	Pay	Achieve	Respect
Ln(pay)	-0.020	0.348	-0.071	0.010
	(0.061)	(0.072)	(0.062)	(0.072)
Range	0.304	0.092	0.346	0.227
	(0.071)	(0.078)	(0.072)	(0.073)
Observations				
Workplaces	366	366	366	366
Individuals	4249	4249	4249	4249
Log-L	-5507.0	-5786.8	-5544.7	-5873.7
Pseudo R^2	0.069	0.142	0.130	0.084

Figure Captions

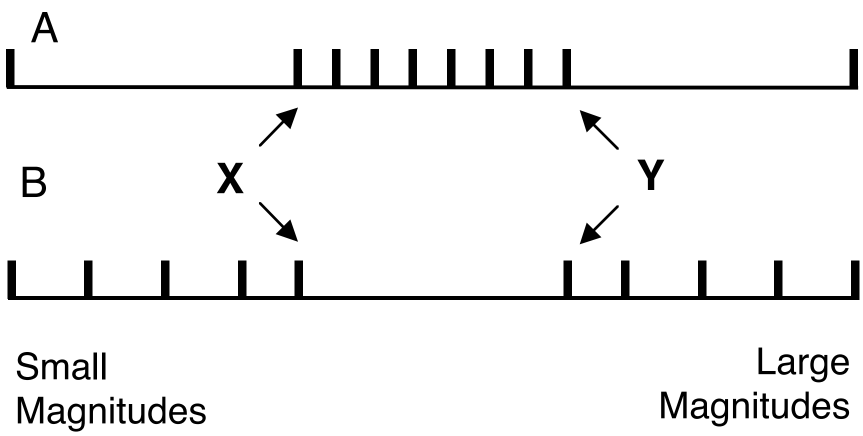
Figure 1. Two hypothetical distributions to illustrate the predictions of rank-dependence.

Figure 2. The six stimulus distributions used in Experiment 1.

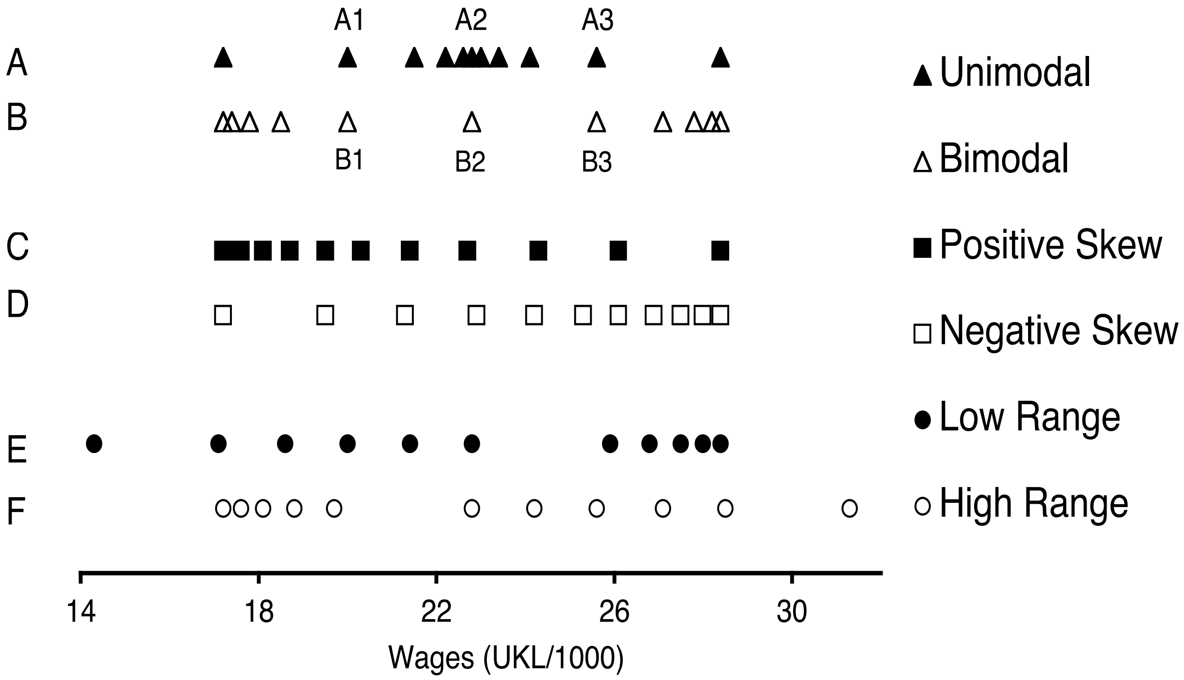
Figure 3. Data (symbols) and fit of the range-frequency model (solid lines) for the six different distributions used in Experiment 1.

Figure 4. Panel A: Hypothetical positively-skewed wage distribution. Panels B-F: Utility functions resulting from wage distribution in Panel A according to model (see text for details).

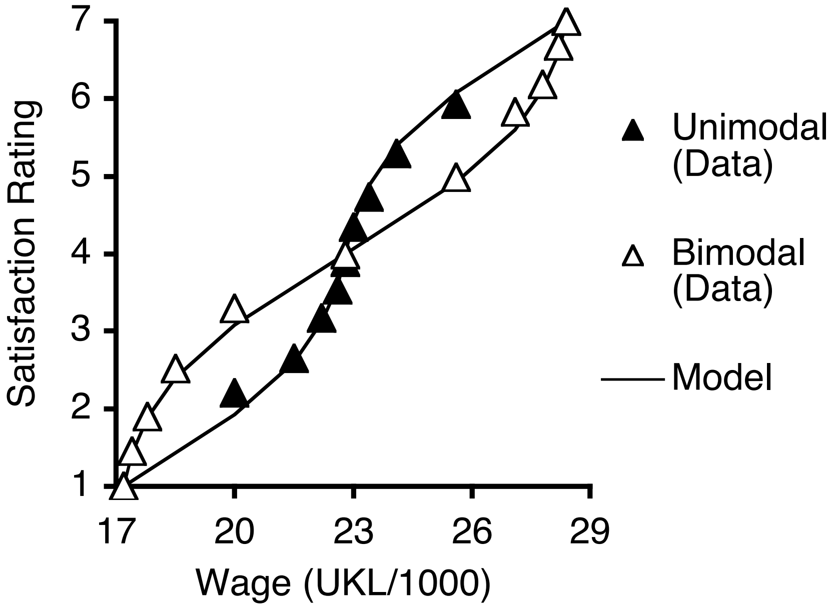
(Figure 1)



(Figure 2)

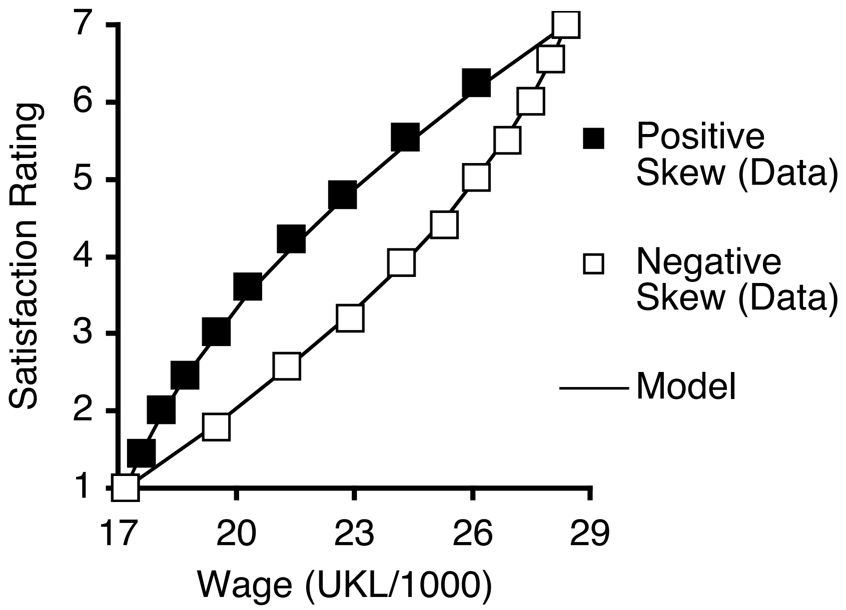

A1
A2
A3
A
B
B1
B2
B3
C
D
E
F
14
18
22
26
30
Wages (UKL/1000)
Unimodal
Bimodal
Positive Skew
Negative Skew
Low Range
High Range

(Figure 3a)

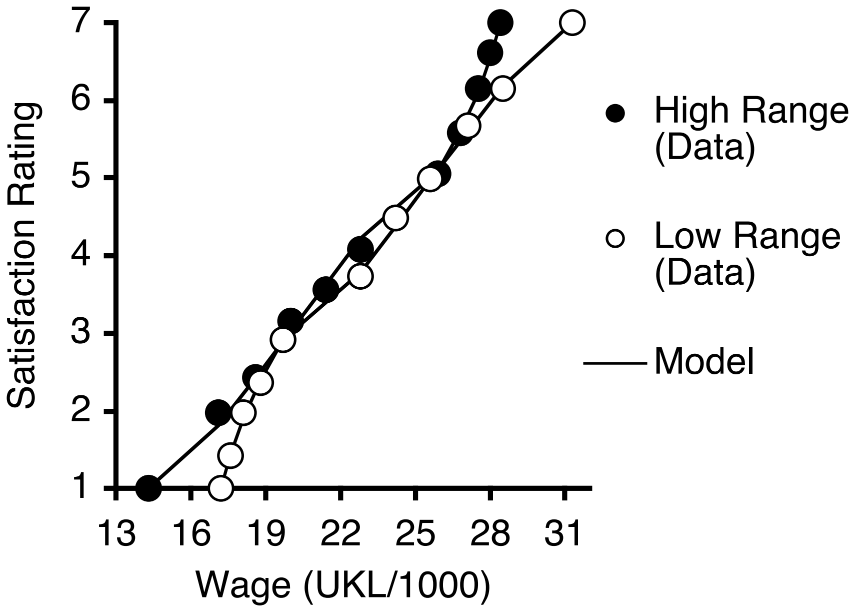


Satisfaction Rating
7
6
5
4
3
2
1
17
20
23
26
29
Wage (UKL/1000)
Unimodal (Data)
Bimodal (Data)
Model

(Figure 3b)

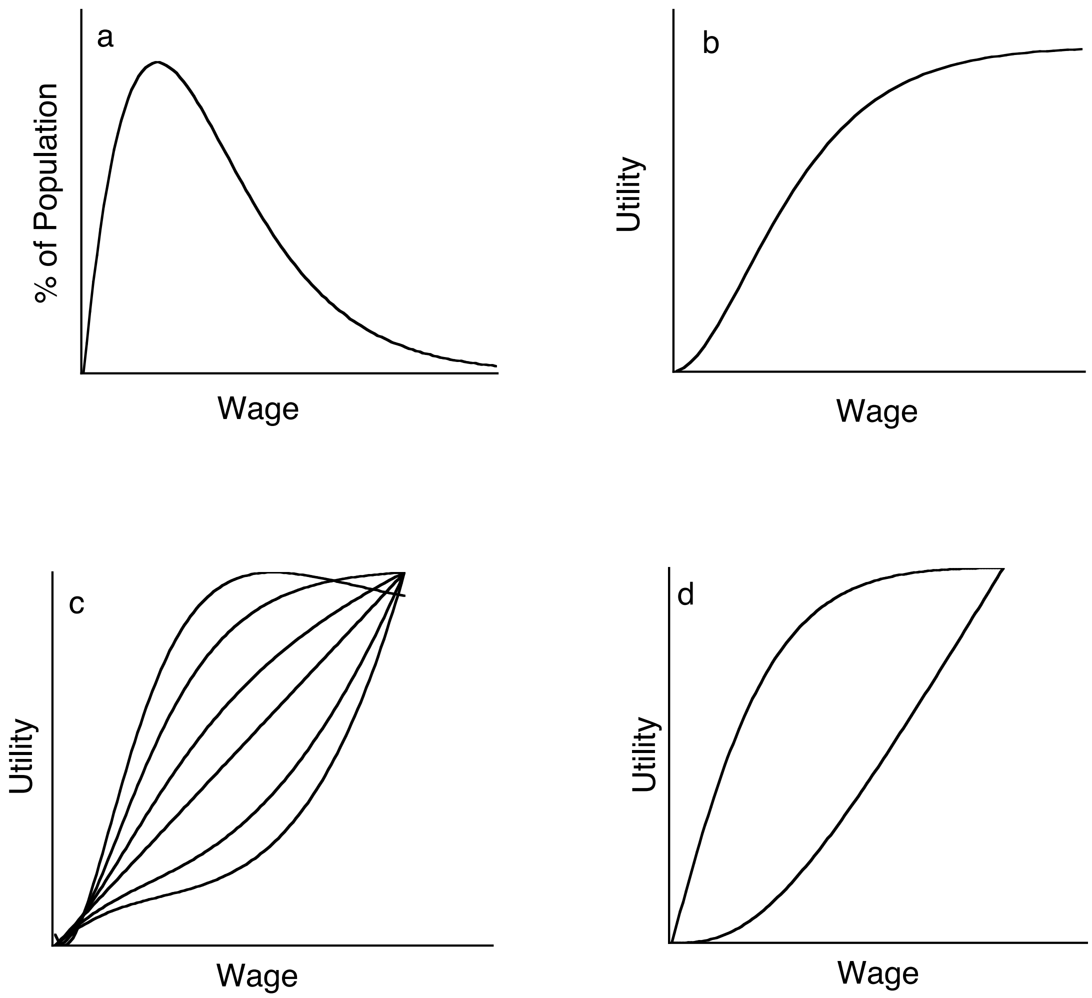

7
6
5
4
3
2
1
Satisfaction Rating
17
20
23
26
29
Wage (UKL/1000)
Positive Skew (Data)
Negative Skew (Data)
Model

(Figure 3c)



Satisfaction Rating
7
6
5
4
3
2
1
13
16
19
22
25
28
31
Wage (UKL/1000)
High Range (Data)
Low Range (Data)
Model

(Figure 4)



a
% of Population
Wage
b
Utility
Wage
c
Utility
Wage
d
Utility
Wage