In Ranyard, R., Crozier, W. R., & Svenson, O. (Eds.).
Decision Making: Cognitive models and explanations.
New York: Routledge (1997)

Chapter 4

Aspects of compatibility and the construction of preference

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One of the most powerful concepts for understanding and aiding judgements and decisions is compatibility. There are several reasons for this. To begin with, compatibility has an impact on many types of perceptual and motor performances. This is because the difficulty of a specific task depends on the particular sets of stimuli and responses that are used in it. Of special importance is how the stimuli and responses are paired with each other. For instance, many studies in cognitive psychology have revealed that subjects' responses are faster and more accurate if they are compatible with the stimuli. Consequently, as has been pointed out by Shafir (1995), subjects' responses to a pair of lights assigned to a pair of keys are faster and more accurate if the left light is assigned to the left key and the right light to the right key (Fitts and Seeger, 1953; Wickens, 1984). Furthermore, a pointing response is faster than a vocal response when a visual stimulus is presented, whereas the reverse holds true when the stimulus consists of an auditory message (Brainard *et al.*, 1962). Compatibility between stimulus and responses has also been shown to be salient for a broad range of other perceptual and motor performance tasks (see, e.g., Kornblum *et al.*, 1990 and Proctor and Reeve, 1990, for reviews).

It has recently been shown that the compatibility between input and output is also a factor in how people construct their preferences in reasoning and decision making. Shafir (1995) has argued that compatibility may contribute to a broad range of biases, including confirmatory biases (Barsalou, 1992), congruence biases (Baron, 1994), verification biases (Johnson-Laird and Wason, 1970) and matching biases (Evans, 1984, 1989). It is argued that violations of the normative principles underlying these forms of biases are due to people's tendency to focus on those instances that are more compatible with the instructions or with the tested hypotheses. An implication of these assumptions is that compatibility between the way in which decision alternatives are described and the way responses are expressed has an impact on how preferences are finally constructed (see, e.g., Slovic, 1995, for a review).

The preference reversal phenomenon has to a large extent contributed to the understanding of the role of compatibility in cognition and decision (Slovic and Lichtenstein, 1983). A preference reversal is said to occur when an individual prefers one alternative in one procedure, but reveals a different preference order in another procedure. For instance, it has been shown that subjects who are presented with two normatively equivalent gambles with the same expected value often make a choice of the gamble with the higher probability. At the same time they indicate a higher selling price for the one with the higher pay-off. Consequently, making a choice between two gambles seems to involve other psychological processes than when the alternatives are being priced separately. The idea of compatibility was introduced as a possible explanation of the preference reversal phenomenon. Compatibility seemed to be able to explain why naming a prize for the gambles was dependent on the pay-off information to such a large extent. Lichtenstein and Slovic (1973) suggested that the compatibility between an attribute and the actual response has an impact on that attribute's influence when the response is made. This reasoning eventually resulted in the *scale compatibility hypothesis*, which states that the weight of a stimulus attribute in a decision or a judgement is increased by its compatibility with the response mode (see, e.g., Slovic *et al.*, 1990; Tversky, 1977; Tversky *et al.*, 1988). The hypothesis finds support in process tracing studies that have shown that response scales may prime the attention to the compatible attribute: pricing judgements prime attention to the amount to be won just as rating scales prime the attention to probabilities (Schkade and Johnson, 1989). In line with this, Chapman and Johnson (1994) reported that scale compatibility occurs if an anchor and a preference judgement are expressed on the same scale. It was also shown by Chapman and Johnson (1995) that semantic categorisation is an important feature of scale compatibility. In life expectancy evaluations, health items were preferred to commodities, whereas in monetary evaluations commodities were preferred to health items.

A parallel line of reasoning emanates from the results of Slovic (1975). In this study, subjects were instructed to make a choice between two equally attractive alternatives. The participants first matched different pairs of alternatives, in that they equated the values of the alternatives of each pair (see below for details of this procedure). Later on, they were instructed to make a choice between the matched alternatives. Slovic found that subjects did not make their choices at random, but instead tended to choose the alternative that dominated on the most important attribute. This reasoning led to the introduction of the *prominence hypothesis* (Tversky *et al.*, 1988), which implies that the most important or prominent attribute looms larger in choice than in matching. The hypothesis thereby asserts that people tend to make choices according to the most important dimension, but they match options by comparing trade-offs along dimensions. For instance, Tversky *et al.* (1988) demonstrated that the majority of their subjects chose the alternative that dominated on the prominent attribute, even though subjects in a parallel task favoured the other alternative.

Tversky *et al.* (1988) suggested that different heuristics or computational schemes may have been triggered in the two types of task. The qualitative nature of choice was seen as more likely than the quantitative nature of matching to lead to a preference for the alternative that dominated on the prominent attribute. This idea was elaborated by Fischer and Hawkins (1993), who suggested that the prominence effect was not restricted to choice and matching, but could be generalised to any comparison between qualitative and quantitative preference tasks. They termed their notion the *strategy compatibility hypothesis.*

TOWARDS A STRUCTURE COMPATIBILITY MODEL

This chapter aims to present a new cognitive model of compatibility which has been briefly introduced elsewhere (Selart, 1996; Selart *et al.*, 1995). It argues that significant compatibility effects can be attributed to how the information is structured and organised in input and output.

As may be seen in Figure 4.1, the model assumes that a compatibility test between the output and the input initially takes place (1). Here, whether the information structure in input is compatible with the information structure of the response mode in output is tested. This test has implications for the selection of decision strategy (2). A lack of compatibility will result in the use of a non-compensatory strategy, whereas compatibility between input and output will lead to the use of a compensatory strategy. The use of decision strategy will in turn affect both the evaluation of the decision outcomes (3) and the implementation of the judgement or decision (4).

Building on the results of Payne (1982) and Hawkins (1994), it is suggested that two general classes of variables play a major part in how subjects construct their preferences. These are task and context effects. Task effects can be related to manipulations of the general structure of the decision, including response mode, number of options or attributes, time pressure and presentation constraints (Bettman, 1982; Klayman, 1985; Russo and Dosher, 1983). Context effects, on the other hand, are connected to manipulations of the content of the decision problem, involving attribute values, similarity of alternatives, attribute covariation, and overall attractiveness of alternatives (Casey, 1991; Johnson *et al.*, 1988; Stone and Schkade, 1991).

Among the task variables, response mode has perhaps been most investigated. As was shown above, earlier models of compatibility emphasised the idea that response mode may either enhance the weight of the

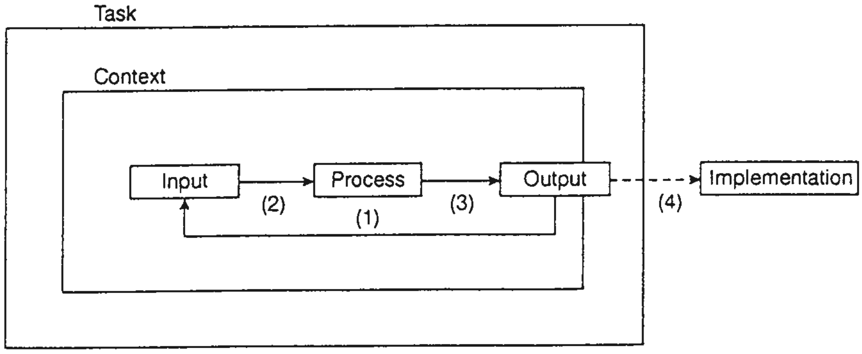

Figure 4.1 A conceptual model of structure compatibility

compatible value attribute (scale compatibility) or prime a particular decision strategy (strategy compatibility). These are alternative explanations of how the response mode in output affects the input (1). The structure compatibility model takes as its point of departure that there are decisions and judgements that prime the same decision strategy because of the compatibility between input and output. An important implication of this is that prominence effects may also occur in judgements. Empirical findings reveal that prominence effects are not restricted to choices. It has been amply shown that the prominent attribute looms larger also in preference ratings (Fischer and Hawkins, 1993; Montgomery *et al.*, 1994; Selart, 1996; Selart *et al.*, 1995; Selart *et al.*, 1994). That is, subjects rate the alternative that dominates on the prominent attribute as more attractive despite the fact that both alternatives have previously been judged as equally attractive in a matching procedure. Hence, it is assumed that the prominence effect cannot be explained in terms of different strategies evoked by judgements and decisions in a general sense. Instead, it is proposed that the prominence effect is due to differences in compatibility between the required output and the structure of input information.

Similar ideas, emphasising the role of structure compatibility, have been put forward by Schkade and Kleinmuntz (1994), who suggest that organisation of elements strongly influences information acquisition strategies. Creyer and Johar (1995) have also noted that task characteristics such as the number of attributes used to describe alternatives influence the prominence effect. We think that similar task demands in choices and preference ratings display a common organisational principle that is different from the one used in matching.

There is also research indicating that compatibility effects may be produced by manipulation of the context. For instance, Parducci (1968, 1974) has shown that different scale continua may influence how a given stimulus is being weighted and judged. One of the findings in his studies was that subjects judged a particular pay-off as satisfying in one such scale continuum but unsatisfying in another. Mellers and Cooke (1994) reported that attribute range influenced the perception of attribute values. It was shown that the effects of a given attribute were greater when presented within a narrow range than within a wide range. This held true for both single-attribute and multiattribute judgements. For example, a monthly rent of $400 seemed worse in a narrow rent range than in a wide rent range.

In this chapter it is assumed that the range of values in the attribute levels of a decision task influences the prominence effect: wide ranges are assumed to increase the effect whereas narrow ranges are thought to decrease it. The rationale behind this notion is that wide ranges stimulate the use of a lexicographic decision strategy, whereas narrow ranges facilitate the use of an additive strategy. Moreover, it must be pointed out that neither the scale compatibility hypothesis nor the strategy compatibility hypothesis predicts any effects of value ranges.

In the following sections of the chapter, structure compatibility is demonstrated in two empirical studies of preferences. A description of the cognitive processes involved is also given in one of the studies where a verbal protocol analysis is performed.

STUDY 1: MATCHING, PREFERENCE AND VALUE RANGE

In many studies a paradigm has been used in which subjects' response outcomes in a matching task are directly compared with their preference statements in choice (e.g., Tversky *et al.* 1988). Building on the model used by Slovic (1975) we, however, let subjects first perform a matching task, in which they were instructed to make pairs of alternatives equally attractive (Selart, 1996). We then let subjects state their preferences for the alternatives to see whether, for instance, they were choosing at random or whether a bias in terms of a prominence effect could be detected.

A new feature of this study was that the value ranges between the attribute levels were manipulated both in the matching task and in the preference task. Thus, in the matching task values on both attributes were expressed on a scale ranging from 0 to 100. The alternatives were constructed by systematically varying the range between the highest and the lowest value on each attribute in steps of 5, 10, 15, 20 or 25 (see Table 4.1). The subjects were undergraduate students at Göteborg University. They were asked to imagine that they were suffering from a disease, and in each problem a pair of treatments were shown. Their task was to provide a missing value so that the options were experienced as equally attractive. The order in which the missing attribute levels were presented was counterbalanced. In the analysis of the matching task we calculated the mean weight ratios between the dimensions in which the mean differences between each attribute were divided.[1] These results revealed that the attribute which we had hypothesised to be experienced as the more important one in fact also turned out to be the prominent one. However, an analysis of variance yielded no reliable effects of value range.

In a subsequent experiment, the mean weight ratios obtained in the matching task were used to construct new sets of stimulus alternatives. In this experiment, subjects' preferences were elicited terms of choices and preference ratings. Also in these tasks the value ranges between the attribute levels were subject to manipulation, as can be seen in Table 4.2.

The instructions were the same as in the matching task, except that subjects were asked to choose between or to rate the options. Choices and preference ratings were scored equivalently, by means of a recoding

Table 4.1 Example of stimuli used in the matching task (Study 1)

	Value ranges				
Pair	*05*	*10*	*15*	*20*	*25*
1	X_1 30 30 35	X_1 30 30 40	X_1 30 30 45	X_1 30 30 50	X_1 30 30 55
2	35 X_2 30 35	40 X_2 30 40	45 X_2 30 45	50 X_2 30 50	55 X_2 30 55
3	35 30 X_3 35	40 30 X_3 40	45 30 X_3 45	50 30 X_3 50	55 30 X_3 55
4	35 30 30 X_4	40 30 30 X_4	45 30 30 X_4	50 30 30 X_4	55 30 30 X_4

Notes:
1 X_1 Highest value on the prominent attribute missing
2 X_2 Lowest value on the prominent attribute missing
3 X_3 Lowest value on the non-prominent attribute missing
4 X_4 Highest value on the non-prominent attribute missing

Table 4.2 Examples of stimuli used in the preference task (Study 1)

Value ranges	*Options*	*Prominent attribute*	*Non-prominent attribute*
Narrow	Treatment A	41[1]	36
	Treatment B	36	46
Narrow	Treatment A	42	37
	Treatment B	37	47
Wide	Treatment A	41	1
	Treatment B	1	78
Wide	Treatment A	42	2
	Treatment B	2	79

Note: 1 The values of the prominent and the non-prominent attributes are expressed on a scale ranging from 0 (very low) to 100 (very high) procedure. In this procedure, preferences for the alternative which dominated on the prominent attribute and preferences for the alternative which was dominated on the same attribute received identical scores in both procedures.

Prominence effects were found in all conditions, that is, both for choices and ratings (see Figure 4.2). The results also revealed that the prominence effect was reliably weaker when the value range was narrow than when it was wide.

One may ask why the manipulation of the value ranges had an impact on the prominence effect in these preference tasks, while it did not affect the mean weight ratios in the matching task. A possible explanation might be that if the range of values is wide between the attribute levels in, for instance, the choice task, then subjects to a greater extent really must 'make a choice between the dimensions', and then the prominent attribute becomes more salient. If, on the other hand, the ranges are narrow in the choice task, then a trade-off between the dimensions will be facilitated, leading to the use of a compensatory decision strategy. The same reasoning applies to preference ratings in which the structure of the task is similar to the one in choice. However, in the matching task this 'either/or' conflict is not to the same extent increased by the wide value ranges.

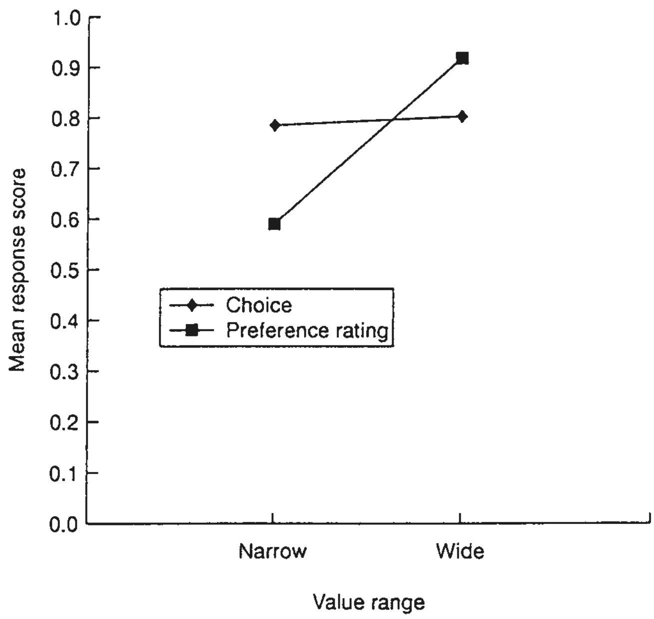

Figure 4.2 Mean response score for different value ranges in Study 1

STUDY 2: A VERBAL PROTOCOL ANALYSIS

Another issue which must be discussed is how this suggested notion of structure compatibility can be measured. Generally, it may be argued that the ratio between the attention given to the input and the output of a task may provide such a measure. But when considering the matching task/preference task anomaly, perhaps subjects also pay more attention overall to the attribute levels in the matching task than they do in a preference task. If so, then this lower degree

of attention could explain the presence of the prominence effect. It may also be plausible to assume that subjects give a more balanced amount of attention to both attributes in the matching task, and that in this task they also compare the attribute levels more often than they do in a preference task.

In order to test these ideas, we designed another study in which the use of verbal protocols was introduced (Selart *et al.*, 1995). Silent control conditions were also conducted (see Russo *et al.*, 1989, for a discussion). The matching task and the preference tasks were constructed and analysed in much the same way as in the first study. An extension was that in the present study we also used acceptance decisions as a complement to choices and preference ratings. Undergraduate students at Göteborg

Table 4.3 Attribute levels of choice problems (medical treatments) presented to subjects (Study 2).

	Attribute	*Option 1*	*Option 2*
1	*Medical care*[1] (1–100)	65	54
	Freedom from disturbance (1–100)	47	62
2	*Health improvement* (1–100)	61	52
	Comfort (1–100)	48	64
3	*Efficiency (1–100)*	*56*	*47*
	Pain relief (1–100)	46	58
4	*Medical skill* (1–100)	59	42
	Freedom from fees (1–100)	35	55
5	*Food value* (1–100)	66	51
	Size of food portions (1–100)	49	63
6	*Protection against relapse* (1–100)	55	40
	Program shortage (1–100)	35	52
7	*Medical follow-up* (1–100)	56	43
	Freedom from encroachment (1–100)	28	59
8	*Communication with staff* (1–100)	66	51
	Leisure (1–100)	46	63

Note: 1 Prominent attribute underlined

University once again served as subjects. The problems which were used are shown in Table 4.3. For each problem, we predicted that one attribute would be prominent and the other one non-prominent.

Our predictions about the salience of these attributes were confirmed, technically, since the mean weight ratios of the matching task were higher than 1.0 for every condition, with some variation (see Table 4.4).

Prominence effects were revealed in all preference tasks, that is, all levels reliably differed from the chance level of 0.50 (Table 4.5).

The processing of the verbal protocols followed a procedure which has been developed in previous research (e.g., Harte *et al.*, 1994; Svenson, 1989; see also Chapter 2). Each statement was coded with respect to (a) which of the alternatives, if any, it referred to; (b) which of the attributes, if any, it referred to; and (c) whether subjects compared two attribute levels or attended to a single attribute level. The results are displayed in Table 4.6.

The analysis of the verbal protocols revealed that the prominence effects obtained in the preference tasks were accompanied by a lower degree of attention to the attribute levels. Subjects also compared attribute levels less frequently in the preference tasks than in the matching task. However, the enhanced attention to the prominent attribute that should have been found in the preference tasks was not as clear-cut.

Still, both the generality of the prominence effect in the preference tasks and the obtained process differences between the matching task and the preference tasks reveal that different kinds of decision strategies seem to be involved in the two kinds of tasks, leading to prominence effects in the preference tasks.

Table 4.4 Mean ratios of weights for prominent and non-prominent attributes in the matching task by preference task (Study 2)

	Choice	*Acceptance decision*	*Preference rating*
Think-aloud condition	1.05	1.24	1.11
Silent condition	1.28	1.32	1.36

Table 4.5 Mean response scores for choice, acceptance decision and preference rating (Study 2)

	Response mode		
	Choice	*Acceptance decision*	*Preference rating*
Think-aloud Condition	0.86	0.72	0.70
Silent condition	0.83	0.76	0.68

Table 4.6 Means of attention to attribute levels in the think-aloud condition (Study 2)

	Prominent option		*Non-prominent Option*	
	Prominent attribute	*Non-prominent attribute*	*Prominent attribute*	*Non-prominent attribute*
Choice condition				
Matching task				
Attribute levels compared	3.75	3.67	3.58	3.83
Attribute levels attended singly	0.25	0.50	0.47	0.58
Preference task				
Attribute levels compared	1.00	0.58	0.50	0.08
Attribute levels attended singly	0.67	0.75	0.17	0.42
Acceptance decision condition				
Matching task				
Attribute levels compared	2.83	2.67	2.75	2.92
Attribute levels attended singly	2.50	1.08	1.17	2.33
Preference task				
Attribute levels compared	1.17	1.00	1.08	0.92
Attribute levels attended singly	0.58	0.17	0.75	0.67
Preference rating condition				
Matching task				
Attribute levels compared	4.83	3.33	4.17	2.83
Attribute levels attended singly	3.00	2.50	1.58	3.75
Preference task				
Attribute levels compared	1.00	0.75	1.67	1.42
Attribute levels attended singly	1.58	0.83	1.17	1.00

The observed process differences also provide an example of how the issue of compatibility can be studied with cognitive data. These data suggest that a low degree of attention to the attribute levels, especially in terms of performed comparisons, seems to be crucial for the prominence effect.

DISCUSSION

In this chapter, it has been shown that structure compatibility effects can be attributed to manipulations both of the task and the context. In two studies, manipulations of the task showed that prominence effects may occur in both choices and preference ratings. This finding was in line with the model which states that choices and preferences involve the same processing mechanism, which is different from the one used in the matching task. Neither the scale compatibility nor the strategy compatibility hypotheses can explain this finding. The scale compatibility hypothesis (Tversky *et al.*, 1988) prescribes the absence of a prominence effect in the rating condition during the described circumstances. This is because the attribute levels used in the present studies ranged from 1 to 100 for both the prominent and the non-prominent attributes, as did the response scales for preference ratings. This should have resulted in a more equal weighting of the attributes in preference ratings than in choices, according to the hypothesis. The failure of the hypothesis corroborates earlier findings that suggest that scale compatibility may operate more readily if prominence effects are absent. The strategy compatibility hypothesis (Fischer and Hawkins, 1993) also suggests a stronger prominence effect in choice, since different kinds of reasoning are assumed to be inherent in choices and judgements independently of the information structure: qualitative response modes are assumed to prime qualitative decision strategies, whereas quantitative response modes are assumed to prime quantitative decision strategies. These differences will in turn lead to differential weighting mechanisms in judgement and choice.

Context effects were investigated by the introduction of different value ranges in Study 1. It was found that, although different value ranges did not have an impact on the weights of the attributes in the matching task, they did affect the prominence effect in both choice and preference rating data. Neither the scale nor the strategy compatibility hypotheses make any context assumptions. However, recent models provided by Mellers and Cooke (1996) may suggest predictions which can be integrated into the model.

Furthermore, an analysis of verbal protocols in Study 2 revealed that subjects made more comparisons between the attribute levels in the matching task than they did in the preference tasks. This finding is in line with the predictions of the model, which assumes that the use of decision strategy should be influenced by the degree of structure compatibility. Similar results have been reported by Hawkins (1994). He tested a set of hypotheses of which a majority concerned processing differences (response time, fixation time) between choice and matching tasks. A computerised information board technique was used in the empirical investigation. First of all, the prominence effect was replicated. It was also found that the matching task in relation to choice had (i) longer total response times, (ii) acquisition of more information, and (iii) longer relative fixation times for the prominent attribute. Furthermore, it was found that a prominence effect between choice and matching could be attributed to relative attention paid to the prominent attribute in choice. These results show clear similarities with the ones obtained in our verbal protocol analysis in which matching and choice also were compared. However, our model also accounts for similar processing differences between matching and preference rating data.

Taken together, our results – and the empirical examples presented from other studies – indicate that it seems necessary to introduce a contingent weighting mechanism that assigns equal importance to input and output information. A structure compatibility model has therefore been proposed in which the importance of both task and context effects is emphasised. From a general point of view, it can be assumed that models of compatibility in judgement and decision must be complex in nature, allowing predictions based on the interaction of several factors. Task effects can be attributed to manipulations of the general structure of the decision, including response mode, number of options or attributes, time pressure and presentation constraints (Bettman, 1982; Klayman, 1985; Russo and Dosher, 1983). Context effects, on the other hand, can be connected to manipulations of the content of the decision problem, involving attribute values, similarity of alternatives, attribute covariation and overall attractiveness of alternatives (Casey *et al.*, 1988; Stone and Schkade, 1991). It is suggested that the notion of structure compatibility will benefit from future research implying both these classes of variables.

NOTE

1 The analyses of the results rested on the assumption that

$$u_{P,p}+u_{P,np} = u_{NP,p}+u_{NP,np} \quad (1)$$

where $u_{P,p}$ and $u_{P,np}$ denote the attractiveness of the levels of the prominent and non-prominent attributes for the prominent option (with the highest value on the prominent attribute), and $u_{NP,p}$ and $u_{NP,np}$ the corresponding attractiveness of the levels of the prominent and non-prominent attributes for the non-prominent option. If the objective attribute levels are denoted x and it is assumed that $u_{i,j} = w_j x_{i,j}$ with w_j denoting the attribute weights, then by substitution in Equation 1:

$$w_p/w_{np} = (x_{NP,np} - x_{P,np})/(x_{P,p} - x_{NP,p}) \quad (2)$$

ACKNOWLEDGEMENTS

The preparation of this chapter was financially supported by grants to the author from the Swedish Council for Research in the Humanities and Social Sciences and from the Royal Swedish Academy of Sciences. I am grateful to the editors, to Tommy Gärling, and to an anonymous reviewer of useful comments.

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