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A Formal Model for the Competency–Demand Hypothesis

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Abstract

The goal of contextualized approaches to personality is twofold: (a) to describe individual differences in situation–response profiles in a parsimonious way and (b) to grasp the psychological mechanisms at the basis of these individual differences. In this paper, it is argued that formal models can be useful to reach this goal. In particular, an item response theory (IRT) model is proposed that formalizes the competency–demand hypothesis, a possible psychological mechanism at the basis of failure behaviour (Wright and Mischel, 1987). The latter hypothesis implies that a person will display a failure response (e.g. aggression) in a situation whenever the demands of the situation are larger than the competency of the person to such an extent that the threshold of the failure response is exceeded. In an empirical study on self-reported hostility in frustrating situations, it is illustrated how the proposed model can be estimated and tested. Copyright © 1999 John Wiley & Sons, Ltd.

INTRODUCTION

Contextualized approaches to the study of personality emphasize that individual differences are not only to be studied in terms of average behaviour of persons (aggregated across situations and responses) but also in terms of the typical behaviour profiles of persons across situations. Situations are conceptualized in terms of active psychological features, the latter being the aspects of the situation that have an impact on the behaviour of the person in that situation (Shoda, Mischel and Wright, 1993; Vansteelandt and Van Mechelen, 1998). For example, during a conversation with a person who has a higher status, one behaves in a more formal way as compared to a situation in which one talks to a close friend; in this case, the type of person present in the situation is the active psychological feature. Situations that have (to the same extent) the same active psychological features are characterized by cross-situational consistency. Mischel and Shoda (1995) call the unique but stable situation–behaviour profile of a person, contextually studied, the behavioural signature of his or her personality.

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The goal of contextualism is twofold: (a) describing individual differences in situation–behaviour profiles in a parsimonious way and (b) understanding the psychological mechanisms at the basis of them. A comprehensive framework to reach this second goal is included in the cognitive–affective personality system (CAPS) theory of Mischel and Shoda (1995, 1998). These authors conceive personality as a system of cognitive and affective units that are activated (or inhibited) in relation to active psychological features. These activated cognitive and affective units—including encodings, expectancies, competencies, and response preferences—activate and/or inhibit in their turn other cognitive and affective units and the total activation of the system ultimately results in a number of responses. Suppose, for example, that person X has made an appointment with another person who does not turn up. In this situation, not keeping the appointment is the active situation feature that may activate the hostile encoding unit of person X, leading to the interpretation that the person intentionally does not turn up; this hostile encoding, in turn, may activate a hostile self-regulatory plan. The fact that the other person is not present in the situation may finally inhibit overt hostile responses (e.g. shouting at the other person) while facilitating covert hostile responses (e.g. feelings of irritation).

The realization of the two above mentioned goals of contextualism is very difficult: the interplay between persons, situations, and behaviours is very complex and the CAPS theory of Mischel and Shoda (1995) only offers a general framework that has to be further elaborated and specified for specific behavioural domains. In this paper, it is demonstrated that formal models can be useful to clarify the complex interplay of persons, situations, and behaviours and to further specify the CAPS theory. In particular, a probabilistic model from the family of item response theory (IRT) models is proposed that formalizes the role of one central CAPS unit, namely competencies.

In the first section of this paper, the competency concept in personality psychology is discussed. In the next section, it is explained how this concept can be captured in a formal model. Then, it is demonstrated in an empirical study how the proposed model can be used for the analysis of real data; in this context, also an extension of the model is discussed. Finally, the last section presents some concluding remarks.

THE COMPETENCY CONCEPT

Throughout development, each person acquires, directly, via personal experience, or, indirectly, via modelling, a large amount of knowledge and information on himself and the world: how should I interact with other persons?; how should I perform certain tasks? Competencies refer to this large amount of well organized information and the ability to use this information in an active way to generate well adjusted cognitions and behaviours in diverse situations (Mischel, 1993); competencies involve information on knowing what to do and how to do it (Paulhus and Martin, 1987; Riemann and Abels, 1994). Many types of competencies, including motor, cognitive, self-regulatory, interpersonal and problem solving competencies can be considered (Paulhus and Martin, 1987; Wright and Mischel, 1987); moreover, within several competencies, different components may be distinguished (Buhrmester, Wittenberg, Reis and Furman, 1988; McFall, 1982). An important property of competencies is that they are defined in relation to specific stimulus conditions or task demands

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located in the situation or environment (Davis and Matthews, 1996; Goldfried and D'Zurilla, 1969; Wright and Mischel, 1987; Wright, Murray, Storey and Williams, 1997). As a result, the concept is contextual (or conditional) in nature (Vansteelandt and Van Mechelen, 1998). In this respect, French, Rodgers and Cobb (1974) argue that competencies and demands should be positioned on commensurate dimensions.

Despite the fact that it is not very clear which information is acquired exactly and which are the particular cognitive processes that are involved in competencies, there is no doubt that there exist substantial individual differences in the range and the quality of cognitions and behaviours that people are able to construct (Mischel, 1990; Riemann and Abels, 1994; Buhrmester *et al.*, 1988). These differences relate to differences in constructive and effective functioning in a variety of situations (Goldfried and D'Zurilla, 1969; Mischel, 1993); stated in other words, persons who have the necessary competencies are able to behave successfully. As to the latter, successful functioning can be conceived in terms of the goodness of fit between the properties of the person and the properties of his or her environment (French *et al.*, 1974). As a result, when a situation requires certain competencies and a person does not know the appropriate behaviour in the situation or is not able to generate it, then he or she often will slip back into rigid failure behaviour such as aggression or withdrawal (Wright and Mischel, 1987) or into maladaptive emotional or physiological reactions (Davis and Matthews, 1996; French *et al.*, 1974; Goldfried and D'Zurilla, 1969). In line with this, Wright and Mischel (1987) state the competency–demand hypothesis; as explained below, this hypothesis implies that individual differences in competency especially show up in demanding situations (Wright and Mischel, 1987). A similar idea can be found in the literature on dispositional attribution (Reeder, Messick and Van Avermaet, 1977; Reeder and Brewer, 1979).

A FORMAL MODEL FOR THE COMPETENCY–DEMAND HYPOTHESIS

The competency–demand hypothesis states that a person will display a failure response in a situation whenever the demands of the situation exceed the competency of the person. In order to formalize this hypothesis, we assume that data are available on different persons i $(1, \ldots, i, \ldots, N_p)$ who (do not) display a failure response (e.g. an aggressive response) in different situations j $(1, \ldots, j, \ldots, N_s)$; in particular, $X_{ij} = 1$ if person i displays a failure response in situation j and $X_{ij} = 0$ otherwise. Technically speaking, this is called an $N_p \times N_s$ binary two-way, two-mode data-matrix (making use of Tucker's terminology for types of data—see Carroll and Arabie, 1980). In the model that will be proposed, it is assumed that all persons i have a position θ_i $(\theta_1, \ldots, \theta_i, \ldots, \theta_{N_p})$ on a competency dimension while all situations j have a position γ_j $(\gamma_1, \ldots, \gamma_j, \ldots, \gamma_{N_s})$ on a corresponding demand dimension. Formally, the competency–demand hypothesis then can be written as follows:

$$X_{ij} = 1 \quad \text{iff} \quad \gamma_j > \theta_i \tag{1}$$

This formulation is deterministic in nature (and notably corresponds to a Guttman scale with scale parameters γ_j and inversion of 0 and 1 responses): when the demands of the situation exceed the competency of the person, the failure response is definitely displayed. A more adequate formulation probably reads that the probability that a

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person will display a failure response in a situation increases when the demands of the situation exceed the competency of the person to a stronger degree. This can be formalized as follows:

$$\text{Logit } P(X_{ij} = 1|\theta_i) = (\gamma_j - \theta_i) \tag{2}$$

Model (2) can be recognized, after a reparametrization in which θ_i and γ_j are substituted by $-\theta_i$ and $-\gamma_j$ respectively, as a simple Rasch model (Fischer, 1995a) with $(N_s - 1)$ independent difficulty parameters; this implies that the demands of the situations (γ_j) and the competencies of the persons (θ_i) can be estimated using ordinary Rasch software.

Failure responses, however, can be displayed in various ways. To take this into account, we propose an extension of the competency–demand hypothesis. More specifically, we assume that each specific failure response has a certain threshold with the response being displayed if its threshold is exceeded. For aggressive failure responses, for example, one may plausibly assume that feelings of irritation have a lower threshold than actually hitting someone. The extended version of the competency–demand hypothesis then reads as follows: a person will display a failure response in a situation when the demands of the situation are larger than the competency of the person to such an extent that the threshold of the response is exceeded. To formalize this extended competency–demand hypothesis, it is assumed that three-way, three-mode data are available that indicate for different persons i $(1, \ldots, i, \ldots, N_p)$ whether they (do not) display different failure responses k $(1, \ldots, k, \ldots, N_r)$ in different situations j $(1, \ldots, j, \ldots, N_s)$; in particular, $X_{ijk} = 1$ when person i displays response k in situation j and $X_{ijk} = 0$ otherwise. The competency of person i is indicated by θ_i $(\theta_1, \ldots, \theta_i, \ldots, \theta_{N_p})$, the demands of situation j by γ_j $(\gamma_1, \ldots, \gamma_j, \ldots, \gamma_{N_s})$ and the threshold of response k by δ_k $(\delta_1 \ldots, \delta_k, \ldots, \delta_{N_r})$. Formally, the extended competency–demand hypothesis then reads as follows:

$$X_{ijk} = 1 \quad \text{iff } \gamma_j - \theta_i > \delta_k \tag{3}$$

This formulation again is deterministic in nature. It may be more plausible that the probability that a person displays a failure response in a situation increases when the demands of the situation are larger than the competency of the person to such an extent that the threshold of the response is exceeded to a stronger degree. Formally, this can be written as follows:

$$\text{Logit } P(X_{ijk} = 1|\theta_i) = [(\gamma_j - \theta_i) - \delta_k] \tag{4}$$

This model (4) is a special case of the linear logistic test model (LLTM) (Fischer, 1995b; Linacre, 1994); the latter, in its turn, is a restricted Rasch model for person by item data (with each situation–response combination being considered as a single item). The Rasch model for a failure response can be written as:

$$\text{Logit } P(X_{ijk} = 1|\theta_i) = (\beta_{jk} - \theta_i) \tag{5}$$

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with a difficulty parameter β_{jk} for each situation–response combination. Model (4) implies a linear restriction on the difficulty parameters β_{jk} of model (5):

$$\beta_{jk} = \gamma_j - \delta_k \tag{6}$$

In model (4), the number of independent situation and response parameters γ_j and δ_k is $(N_s + N_r) - 2$ (which corresponds to the rank of the linear system (6)). The fact that model (4) is a special case of the LLTM implies that it can be estimated using standard LLTM software. When analysing a data set, first the Rasch model (5) will be estimated and tested; afterwards, when the Rasch model (5) fits to the data, it will further be examined whether the LLTM (4) with the restrictions implied by (6) holds; model (5) can be tested using a R1c-statistic (Glas and Verhelst, 1995) and model (4) can be tested against model (5) using a likelihood ratio statistic (Fischer, 1995b).

With respect to testing models (5) and (4), an additional comment can be made: when the Rasch model (5) fits to the data but the LLTM (4) does not, this means that there is a single competence dimension underlying the data, but that the difficulty of each situation–response combination cannot be written as a simple sum of a basic situation parameter and a basic response parameter. This implies an interaction between situations and responses with regard to the difficulty of the situation–response combinations. A possible psychological mechanism at the basis of such an interaction is that the threshold of a response may vary as a function of how (in)appropriate the response is in the situation, under the assumption that the appropriateness of responses varies across different situations (Price, 1974; Price and Bouffard, 1974). Shouting at your boss is, for example, very inappropriate and this will result in a higher increase of the threshold of the response of shouting in this situation while this may not be the case in a situation in which your partner is present. When a judgement A_{jk} is available with respect to how appropriate response k is in situation j for each situation–response combination jk (e.g. a judgement from an expert), model (4) can be extended as follows:

$$\text{Logit } P(X_{ijk} = 1|\theta_i) = [(\gamma_j - \theta_i) - (\delta_k - \zeta A_{jk})] \tag{7}$$

with ζ being the weight of the appropriateness judgements A_{jk}. The difficulty of situation–response combination jk in model (7) is determined by the demand of the situation (γ_j), the threshold of the response (δ_k) and the weighted appropriateness judgement of the situation–response combination (ζA_{jk}). Model (7) has one parameter more (ζ) than model (4) and is also a special case of the LLTM; it can be estimated using standard LLTM software. Model (7) can be tested against model (5) using a likelihood ratio statistic (Fischer, 1995b).

ILLUSTRATIVE APPLICATION

The aim of this study is to illustrate how model (4), which formalizes the competency–demand hypothesis, can be estimated and tested using empirical data. The data are on self-reported hostile behaviour, a failure behaviour, in frustrating situations. Experimental research concerning delay of gratification in children indicates that there exist important individual differences in the competency to tolerate frustration (Rodriguez, Mischel and Shoda, 1989; Stumphauzer, 1972). Moreover, individual differences in

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this competency are related to individual differences in destructive, aggressive behaviour (Shoda *et al.*, 1993; Shoda, Mischel and Wright, 1994; Wright and Mischel, 1987).

Model (4) is well suited to examine the competency–demand hypothesis in cases with situations that impose requirements on persons with respect to a single competency or, stated in other words, in cases with situations that vary unidimensionally with respect to a single active situation feature. Model (4) further also presupposes failure responses with thresholds that vary along a simple threshold dimension. Therefore, to apply model (4) in an adequate way, it should be tested using situations and responses to which the just mentioned properties apply. This is what was done in the study on hostility. For the situations, 14 situations were taken from an existing Situation–Response Inventory of Hostility (Endler and Hunt, 1968). Previous research (Vansteelandt and Van Mechelen, 1998) suggests that these situations vary across a single quantitative frustration dimension (Gati and Tversky, 1982) with persistence and severity of the consequences of the frustration in the situation as active situation features. On the basis of the same study (Vansteelandt and Van Mechelen, 1998), four hostile responses were selected that varied in frequency of occurrence along a single response dimension.

Model (4) will be applied to data on self-reports of each of the selected responses to each of the situations. This will result into estimates of (a) the demands of the situations, (b) the thresholds of the responses and (c) the competencies of the persons. To examine whether these estimates are also psychologically meaningful, we will relate them to characteristics of the situations, responses and persons respectively, as collected in additional judgements.

If in the statistical testing, the Rasch model (5) turns out to be accepted whereas the LLTM (4) is rejected, model (7) will be estimated and tested using expert judgements on the appropriateness of each response in the respective situations. The latter model implies that the thresholds of the responses may vary as a function of response appropriateness in the different situations (Price, 1974; Price and Bouffard, 1974).

Method

In this section, we successively discuss the collection of three sets of data: (1) situation–response data (S–R data) and subject characteristics, (2) situation and response characteristics, and (3) appropriateness judgements of the responses in different situations.

S–R data and subject characteristics

Participants. The participants were 316 first-year psychology students at the Department of Psychology of the University of Leuven. Participation in the study was a partial fulfillment of a requirement to participate in research. The sample consisted of 73 males and 243 females (which reflects the sex proportion in first-year psychology in Belgium). The average age was 18.4 (SD = 1.2, $n = 316$).

Situation–Response questionnaire. Fourteen situations were taken from an S–R inventory of hostility developed by Endler and Hunt (1968). An example of a situation is 'Your instructor unfairly accuses you of cheating on an examination.' All 14 situations are presented in Table 1.

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Table 1. Estimated situational demands and average judgments (across judges) of situations with respect to two situational features

Situations	γ	SF1	SF2
1. You are trying to study and there is incessant noise	1.54	4.9	5.2
2. You have just found out that someone has told lies about you	1.24	5.8	5.3
3. You are driving to a party and suddenly your car has a flat tyre	1.11	3.9	2.7
4. You are waiting at the bus stop and the bus fails to stop for you	1.08	3.8	3.3
5. Your instructor unfairly accuses you of cheating on an examination	0.96	6.1	6.4
6. You arrange to meet someone and he (she) doesn't show up	0.90	4.2	3.4
7. Someone has opened your personal mail	0.81	5.6	5.3
8. Someone has lost an important book of yours	0.51	5.5	4.5
9. You are talking to someone and he (she) does not answer you	0.00	2.4	3.1
10. You are in a restaurant and have been waiting a long time to be served	−0.04	3.4	1.9
11. You accidentally bang your shins against a park bench	−0.17	2.9	2.7
12. You are carrying a cup of coffee to the table and someone bumps into you	−0.23	2.5	2.4
13. You wake up early to get a special 8 a.m. class and the instructor doesn't show up	−0.88	2.4	1.4
14. You are very tired and have just gone to sleep, when you are awakened by the arrival of some friends	−1.01	3.0	2.1

Note: γ = estimated situational demand. The features were judged on a seven-point scale labelled in terms of the features; the number of judges is 10. SF1 = persistence of the frustration and SF2 = severity of consequences of the frustration. From Endler and Hunt, 1968, pp. 310–311. Copyright 1968 by the American Psychological Association. Adapted by permission of the author.

Four responses varying in frequency of occurrence along a Guttman scale (Vansteelandt and Van Mechelen, 1998) were selected from the Endler and Hunt (1968) inventories: become tense, feel irritated, curse, and want to strike something or someone.

All fourteen situations and four responses were combined resulting in 56 situation–response combinations, which were presented in random order to the participants. For each situation–response combination, the subjects had to indicate on a three-point scale the extent to which he (she) displayed the response in the situation in question:

0 = you do not display this response in this situation
1 = you display this response in this situation to a limited extent
2 = you display this response in this situation to a strong extent

Subject characteristics. Two questionnaires on anger and hostility were used as measures of external subject characteristics; namely the *Zelf-Analyse Vragenlijst* (*ZAV*) (Van der Ploeg, Defares and Spielberger, 1982), which is the Dutch adaptation of the State–Trait Anger Scale (STAS) (Spielberger, 1980) and the Buss–Durkee Hostility Inventory—Dutch (BDHI-D) (Lange, Hoogendoorn, Wiederspahn and de Beurs, 1995). The latter questionnaire includes three subscales labelled direct aggression (DA), indirect aggression (IA), and social desirability (SocD). High scores on the ZAV and the DA and IA scales can be considered self-report measures of lack of frustration tolerance.

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Procedure. First, subjects had to fill out the situation–response questionnaire and next the ZAV and the BDHI-D.

Analysis. Data were dichotomized (0 versus 1 or 2) and subjected to the one parameter logistic model (OPLM) algorithm of Verhelst, Glas and Verstralen (1994) to estimate models (4), (5) and (7). OPLM provides conditional maximum likelihood (CML) estimates of the situation and response parameters and weighted likelihood estimations (WLE) of the person parameters (Warm, 1989).

Situation and response characteristics

Judges. The judges were six male and four female staff members of the Department of Psychology of the University of Leuven.

Materials. The judgement task was part of a larger study (Vansteelandt and Van Mechelen, 1998). Only the characteristics that are relevant for the present study are mentioned here. These characteristics include two situation features that are related to the presumed situational demand dimension. The features and their definitions as presented to the judges were the following:

(1) Persistence of the frustration in the situation: the duration of the frustration in the situation, which can be long or rather short.
(2) Consequences of the frustration in the situation: the consequences of the frustration in the situation, which can be minimal or severe.

Furthermore, the following three response features were considered:

(1) Extrapunitive: the response to the frustration is directed to the source of the frustration.
(2) Automatic reaction–intentional action: the response to the frustration is a purely automatic reaction versus a conscious intentional action undertaken by the person.
(3) Physiological: the response to the frustration is purely physiological in nature.

Procedure. The judgment task was computer administered. Each expert had to judge first the situations with respect to the situation features and next the responses with respect to the response features. All situations (responses) first had to be judged with respect to the first feature, next with respect to the second feature, etc. The degree to which a situation (response) feature was applicable to a situation (response) had to be marked on a seven-point scale that was labelled in terms of the involved feature. For the situations '1' indicated that the frustration in the situation was short and had minor consequences and '7' indicated that the frustration was long and had major consequences. For the responses '1' indicated that the response was not extrapunitive, automatic and not physiological and '7' indicated that the response was to a large extent extrapunitive, conscious–intentional and physiological. The two sets of features were presented in random order and within each feature the situations (responses) were presented in random order.

Analysis. To check the interrater reliability of the feature judgments, Cronbach's coefficient alpha (for non-normalized data) was calculated per feature. All situation and response features had alpha-values above 0.90.

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Appropriateness judgements

Judges. The judges were eight male and two female staff members of the Department of Psychology of the University of Leuven.

Materials and procedure. The 14 situation × 4 response combinations had to be judged with respect to how (in)appropriate the response is in the situation (Price, 1974; Price and Bouffard, 1974). The instructions were as follows:

> From different experiences in daily life people often have developed an impression on the extent to which certain responses are appropriate or inappropriate in certain situations. In the following task, a series of situation–response combinations of the type 'someone makes a prickly remark–curse' is presented to you. You are asked to judge each situation–response combination with regard to the extent to which the response is appropriate in the situation on a 7-point scale with 1 = the response is extremely inappropriate in the situation and 7 = the response is extremely appropriate in the situation.

The judgement task was computer administered. Each expert had to judge all 56 situation–response combinations, which were presented in random order. Cronbach's coefficient alpha (for non-normalized data), as a measure of interrater reliability of the judgements, was 0.92.

Results and discussion

The main aim of this study was to estimate and test model (4), which formalizes the competency–demand hypothesis. First, as a prerequisite for model (4) to hold, the Rasch model (5) was estimated and tested for the 316 persons × 56 situation–response combinations. The Rasch model appeared to fit the data ($R1c(165) = 190.24$, $p = 0.09$). Next, model (4) itself was estimated. The leftmost column of Table 1 presents the estimates of the situational demands and the leftmost column of Table 2 the estimates of the response thresholds. From Table 1, it appears, for example, that the situation 'You are trying to study and there is incessant noise' (1.54) is more demanding than the situation 'You are very tired and have just gone to sleep, when you are awakened by the arrival of some friends' (−1.01).

In Table 2, it can be seen, for example, that 'feeling irritated' (−1.37) has a much lower threshold than 'want to strike something or someone' (2.56). In general, the most demanding situations (e.g. incessant noise, lies about you, flat tyre) are

Table 2. Estimated response thresholds and average judgments (across judges) of responses with respect to three response features

Responses	δ	RF1	RF2	RF3
1. Feel irritated	−1.37	3.4	4.1	1.7
2. Become tense	0.00	2.5	5.8	1.4
3. Curse	0.39	4.7	2.4	4.0
4. Want to strike something or someone	2.56	5.1	3.0	4.3

Note: δ = estimated response threshold. The features were judged on a seven-point scale in terms of the features; the number of judges is 10. RF1 = extrapunitive, RF2 = physiological, RF3 = automatic reaction–intentional action.

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characterized by high levels of frustration unlike the least demanding ones (e.g. the instructor who does not show up, the arrival of friends). The demand dimension can therefore be interpreted as a quantitative amount of frustration dimension. As to the response threshold dimension, responses with lower thresholds are less intrusive and less externally directed than their counterparts with higher thresholds.

To further validate this interpretation, the situation, response, and person parameters were related to the situational, response, and person features, respectively. The two rightmost columns of Table 1 present the average expert judgements per situation for the features persistency and severity of consequences of the frustration. The correlations between the estimated situational demands, on the one hand, and the two situational characteristics, on the other hand, are identical and high: $r(14) = 0.74$, $p = 0.003$ (the correlation between the two situational features being $r(14) = 0.91$, $p = 0.0001$). These results imply that the situations indeed constitute a quantitative dimension that may be called persistency of frustration or severity of consequences of the frustration; this result is in line with Vansteelandt and Van Mechelen (1998).

The three rightmost columns of Table 2 present the mean expert judgements with respect to the three response features. Although the rank order of the estimated thresholds and the response features is not exactly the same, visual inspection indicates that, in general, the responses with the lowest thresholds (feeling irritated and feeling tense) are more automatic and reactive, while the responses with the highest thresholds (cursing and want to hit something/someone) tend to be conscious, intentional and extrapunitive. Stated in Skinnerian terms (Funder and Colvin, 1991) operants (i.e. responses for which no clear eliciting stimulus can be detected) have higher thresholds than respondents (i.e. being responses correlated with a clear, identifiable eliciting stimulus). This finding is plausible given that the situations in this study all involve a clearly eliciting stimulus condition.

The correlations between the estimated person parameters of model (4) and the self-reports of the subjects with respect to frustration tolerance were -0.29 for State–Trait Anger and -0.28 and -0.24 for the direct and indirect aggression subscales of the BDHI-D. In general, all correlations are significant ($p < 0.0001$) but rather small, which means that the estimated competence levels are only weakly related to decontextualized self-reports of frustration tolerance.

It must be noted that the likelihood ratio statistic testing model (4) against model (5) takes a significant value, $\chi^2(39) = 1182.93$, $p < 0.001$; yet, from a multiple regression analysis with the 56 (14 situations $\times$ 4 responses) difficulties β_{jk} of model (5) as a criterion and dummy variables for each situation and response as predictors, it appears that 87 % of the variance in β_{jk} can be accounted for by the main effects of situations and responses; $R = 0.933$, $F(16,55) = 16.37$, $p = 0.0001$. The latter result implies partial support for model (4). As a rule of thumb, however, for an LLTM to be satisfactory R values of around 0.98 are desirable. We may therefore conclude that there seems to be a nonnegligible situation–response interaction with respect to the difficulties of the situation–response combinations, possibly based on differences in response appropriateness across situations. To test the latter hypothesis, model (7) was tested against model (5), resulting in a much lower, although still significant, likelihood ratio statistic, $\chi^2(38) = 302.54$, $p < 0.001$; a multiple regression with the difficulties β_{jk} of model (5) as criterion and dummy variables for each situation and response together with the appropriateness judgements A_{jk} as predictors now

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accounted for 95% of the variance in β_{jk}, $R = 0.975$, $F(17,55) = 46.91$, $p = 0.0001$. As expected, the weight of the appropriateness judgements appeared to be positive ($\zeta = 0.87$), meaning that the threshold of a response is higher when that response is less appropriate in the situation (which, for example, is the case for 'cursing' when 'an instructor unfairly accuses you of cheating on an examination'). This finding is in line with research that indicates that persons adjust their responses to suit the social situation (Paulhus and Martin, 1987; Price, 1974; Price and Bouffard, 1974) and, especially, the immediate audience (Higgins, 1990).

CONCLUDING REMARKS

At the onset of this article, we stated that formal models may be useful to describe individual differences in situation–response profiles in a parsimonious way and to grasp the psychological mechanisms at the basis of them. In this paper, we have shown indeed that model (5) yields a parsimonious description of individual differences in situation–response profiles by assigning a competency parameter to each person; on the basis of this parameter, it is possible to calculate, for each situation, the probability that the person in question will display a particular failure response in that situation. Model (4) also explicitly formalizes a well defined psychological mechanism at the basis of individual differences in hostility, that is, the extended competency–demand hypothesis. Moreover, this mechanism is still further refined in model (7) by allowing the response thresholds to vary as a function of response appropriateness in the situation. Taken as a whole, model (7) elaborates and specifies how, within the CAPS framework of Mischel and Shoda (1995, 1998), competencies and failure behaviour can be understood in relation to active situation features. It is obvious that the competency–demand hypothesis also holds for competencies other than frustration tolerance including motor, social, or other competencies, and that model (4) can be used to examine them. Furthermore, model (4) also allows the formalization of other CAPS variables. In particular, in their person–environment fit theory, French *et al*. (1974) conceptualize adjustment as goodness of fit between the properties of the person and the properties of the environment. In this respect, they draw an interesting distinction between two kinds of demand and two kinds of corresponding supply: (a) demands that originate from the person and that must be met by environmental supplies (e.g. a person is hungry and the environment has to supply food—these are called needs and supplies; and (b) demands that originate from the environment and that must be met by the person (e.g. requirements for a job that have to met by an applicant)—these are called demands and abilities. With respect to competencies, it is clear that the demands originate from the environment, while the person has to meet them. Model (4), obviously, can also be used to model demands originating from the person and that have to be met by the environment or situation. In the case of goals, a person can, for example, have a certain goal while the situation can meet this goal to a limited or strong extent. Suppose, by way of illustration, that a person has the goal to obtain a certain amount of attention from his or her partner; then, it is plausible to assume that this person will display a failure response (e.g. feeling irritated) when the partner does not meet his or her expectations. In this case, persons can be characterized by the extent to which they pursue a certain goal (e.g. obtaining attention) and situations can be characterized by the extent to which they meet the goal (e.g. the

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amount of attention given by the partner). This idea can be formalized by model (4) in a straightforward way, with again features of both persons and situations being located on commensurate dimensions as advocated by French *et al*. (1974).

The proposed models are uni-dimensional and relatively simple; as such, they offer a good starting point for describing and clarifying the complex interplay between persons, situations and responses. However, several more complex extensions of the models are possible and perhaps also desirable. Two examples of such extensions will be mentioned here. A first extension of the models may be necessary when the situations turn out to require simultaneously different competencies (e.g. cognitive and motor competencies). In this case, multi-dimensional models are necessary (a) in which both persons and situations are located on the different competency dimensions and (b) which include a rule that specifies the interplay of the different competency dimensions; an example of the latter is a conjunctive rule that states that a person will display a failure response in a situation when the demands of the situation exceed the competency of the person on *all* dimensions (Maris, 1992). A second possible extension of the model is related to the appropriateness of the responses in the situation. Model (7) assumes that the dependence of the response thresholds on response appropriateness is the same for all persons. However, it is possible that persons differ in sensitivity for response appropriateness of responses. The latter idea can be formalized by extending model (7) in such a way that different appropriateness weights ζ are allowed in different subgroups of persons.

Taken as a whole, the proposed models and their possible extensions seem to provide useful instruments (a) to understand and clarify the competency concept in relation to failure behaviour in particular, and (b) to set-up contextualized studies on personality more in general. With respect to the latter, the models in question may be useful both to formalize and refine our existing contextualized theories of personality and to give rise to new theoretical developments in this domain.

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