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Available online: 14 Jun 2011

To cite this article: Uwe Matterne, Thomas L. Diepgen & Elke Weisshaar (2011): A longitudinal application of three health behaviour models in the context of skin protection behaviour in individuals with occupational skin disease, Psychology & Health, 26:9, 1188-1207

To link to this article: http://dx.doi.org/10.1080/08870446.2010.546859

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A longitudinal application of three health behaviour models in the context of skin protection behaviour in individuals with occupational skin disease

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(Received 7 May 2010; final version received 3 December 2010)

Occupational skin disease (OSD) is common, associated with poor prognosis and poses a significant burden to the individual and society. We applied the theory of planned behaviour (TPB), the prototype-willingness model (PWM) and the health action process approach (HAPA) to the prediction and explanation of occupationally relevant skin protection behaviour in individuals with OSD. We used a longitudinal design. In this study, 150 individuals participating in a 3-week inpatient tertiary prevention programme completed measures assessing the constructs of the TPB, PWM and HAPA at admission (T0), discharge (T1) and once the individual had returned to work and worked for 4 consecutive weeks (T2) (n = 117). Intention was measured at T0 and skin protection behaviour at T2. Path analysis was used to assess the longitudinal associations of the models’ constructs with intention and skin protection behaviour. TPB as well as PWM variables accounted for 30% of variance in behaviour, HAPA variables for 33%. While not all predictions were confirmed by the data, all three models are able to inform us about the formation of skin protection intention and behaviour in individuals with OSD. The findings are discussed in light of future interventions and research.

Keywords: theory of planned behaviour; prototype-willingness model; health action process approach; skin protection behaviour; occupational skin disease

Introduction

Occupational skin disease (OSD) is the most common occupational hazard in industrial countries, hence constituting a significant public health concern (Diepgen & Kanerva, 2006; Kralj, Michaelis, & Hofmann, 2000; Lushniak, 2003). Moreover, although registers of OSD are kept in several European and Asian countries as well as the United States, they are usually incomplete as a result of underdiagnosis and underreporting of the disease. Thus, the actual incidence of OSD may be underestimated (Diepgen & Kanerva, 2006; Lushniak, 2003). OSD is not only common but its prognosis is also poor (Diepgen & Kanerva, 2006) and it poses...
a major burden to the individual (Coenraads, Bouma, & Diepgen, 2004) as well as society (Lushniak, 2003). The causes for OSD are varied and assumed to be multifactorial. Skin disease in general is often quite simply described as an inflammation of the skin, and can arise as a result of atopy (diathesis), contact and exposure to irritants and allergens or sometimes infection. In the workplace, all three factors as well as their interactions may be involved (Buxton & Morris-Jones, 2009; Coenraads, 2007).

**Preventive measures and OSD**

It is an important goal for health professionals to foster individual behaviour that reduces the formation of OSD (primary prevention) or the chance of reappearance after rehabilitation (tertiary prevention). Primary prevention strategies aim at reducing the incidence by ‘lowering the rate of new cases’ (Caplan, 1964, p. 89) and have successfully been applied to individuals working in hazardous professions in whom OSD was still absent (Kütting et al., 2010). Secondary prevention efforts which seek to lower the prevalence of disease in a given population (Caplan, 1964, p. 89) have also been successfully applied to individuals with suspected OSD (Dickel, Kuss, Schmidt, & Diepgen, 2002). Individuals, for whom primary or secondary prevention strategies have been unsuccessful, can still be addressed by tertiary prevention strategies. They attempt to prevent chronification or aim at relapse prevention, respectively (Manz, 2002). There are tertiary prevention programmes addressing the needs of individuals with severe and refractory OSD (Matterne, Diepgen, & Weissshaar, 2009; Skudlik et al., 2008) which have been shown to be effective in enabling afflicted individuals to remain in their profession (Schwanitz et al., 2003). One of the main objectives of all three approaches (primary, secondary and tertiary) is to improve individual skin protection behaviour. It not only consists of measures that protect and restore the skin barrier by the regular application of skin protection and skin care products but also includes prudent hand washing and the avoidance of irritants and allergens.

**Skin protection behaviour from a health-psychological perspective**

Although health behaviours in general have been defined as ‘Any activity undertaken by a person believing himself to be healthy for the purpose of preventing disease or detecting it at an asymptomatic stage’ (Kasl & Cobb, 1966), concern has been voiced over this older approach to be too narrow and exclude people with recognised illnesses (Conner & Norman, 2005). A newer conceptualisation defines health behaviour as ‘those personal attributes […] that relate to health maintenance, to health restoration and to health improvement’ (Gochmann, 1997, p. 3). Systematic skin protection measures performed by individuals with OSD can thus be considered a health behaviour since performing that behaviour affects one’s health once rehabilitation has been successful. Behavioural change, for instance learning to adhere to optimal and rigorous personalised skin protection measures not only applies to primary but also to tertiary prevention, too, although in the latter medical assessment and therapy are also crucial parts of the strategy. Once the individual is cleared of OSD, it is of paramount importance, however, to change one’s behaviour in order to prevent potential relapse. A large part of the risk of
relapse can be attributed to a lack of or inappropriate skin protection behaviour (Schwanitz et al., 2003).

Many conceptualisations of health behaviour are subsumed under the umbrella term of social-cognitive models of health behaviour and have played a significant role in helping us to understand many health behaviours (Conner & Norman, 2005). However, to date, no study has investigated whether skin protection behaviour in individuals with OSD can be modelled by such theory.

The **theory of planned behaviour** (TPB) has emerged as one of the most influential theoretical frameworks for the study of human behaviour (Ajzen, 1991, 2002a) and is a popular conceptual model for explaining informational and motivational influences on behaviour. It provides a conceptual account of the way in which attitude, social norms and perceived behavioural control (PBC) predict intention which in turn with the latter are seen as the proximal predictors of behaviour. The TPB has been used extensively to understand health behaviour (Armitage & Conner, 2001; Conner & Sparks, 2005) and is beginning to be used as a foundation for health behaviour interventions (Hardeman et al., 2002).

The **prototype-willingness model** (PWM) (Gerrard, Gibbons, Houlihan, Stock, & Pomery, 2008; Gibbons, Gerrard, Blanton, & Russell, 1998; Gibbons, Houlihan, & Gerrard, 2009) has been developed to additionally account for influences on behaviour that are not planned or reasoned as for example suggested by the TPB. Two pathways to behaviour are proposed: a reasoned action path similar to the TPB (but without PBC) and a social reaction path via behavioural willingness. Originally devised to explain the formation of risk behaviour in adolescents, the PWM has since been applied to the prediction of other health behaviours in adults (Dalley & Buunk, 2009) often by extending the TPB with PWM components (e.g. Rivis & Sheeran, 2003b; Rivis, Sheeran, & Armitage, 2006). Non-adherence to skin protection measures in individuals with suspected OSD poses a risk for the individual. It thus appears reasonable to investigate whether the PWM contributes to the explanation and prediction of adherence to personalised skin protection measures in the workplace.

The **health action process approach** (HAPA) (Schwarzer, 2008a) generically takes a stage approach to the explanation and prediction of health behaviour (change) as it suggests a distinction between a pre-intentional motivation (during which risk perception, outcome expectancies (OEs) and self-efficacy (SE) play a role) and a post-intentional volitional phase (during which self-regulatory processes such as planning and SE play a role in initiating and maintaining behaviour). When predicting behaviour, it can, however, also be used in the sense of continuum models (Schwarzer, 2008b). The need for more complex models of health behaviour becomes apparent when one looks at the amount of variance that is usually accounted for by variables derived from continuum models. TPB variables, for instance account for 39% of variance in intention and 27% in behaviour according to the most recent meta-analysis of 185 studies using the TPB (Armitage & Conner, 2001).

Planning has shown potential in bridging the intention–behaviour gap (e.g. Chapman, Armitage, & Norman, 2009; Sniehotta, 2009) and is seen as a key variable in the volitional phase according to HAPA. Recently, a division of planning into action planning and coping planning has been suggested (Sniehotta, Schwarzer, Scholz, & Schulz, 2005). The model has been tested with regard to a variety of health behaviours (Luszczynska & Schwarzer, 2003; Schwarzer et al., 2007; Schwarzer, Luszczynska, Ziegelmann, Scholz, & Lippke, 2008) and most studies were able to
confirm important predictions of the model, although, to date, no meta-analyses assessing HAPA’s explanatory and descriptive power across behaviours have been conducted yet.

Very few studies (e.g. Garcia & Mann, 2003; McClanahan, Shevlin, Adamson, Bennett, & O’Neill, 2007; Orbell, et al., 2009) have attempted to apply different health behaviour models simultaneously. However, as each model has strengths and weaknesses, such an approach may be fruitful as it can help us to identify factors that are particularly important in shaping a specific health behaviour and offer scope for integration (Noar & Zimmerman, 2005). A literature search using the relevant databases (PubMed, Medline, PsycINFO and PSYNDEX) failed to find any studies applying the TPB, PWM and HAPA in one study to the same outcome.

Purpose of this study

Although a growing body of research has addressed skin protection behaviour in primary prevention contexts (Mahler, Kulik, Butler, Gerrard, & Gibbons, 2008; White et al., 2008), to date no otherwise established health behaviour theory has yet been applied to the prediction and explanation of skin protection behaviour in individuals with OSD whilst simultaneous applications of different health behaviour formulations are rare in general. We chose the TPB because it has shown good predictive power in many domains, the PWM because it also accounts for social reaction processes and HAPA because it contains an explicit measure (planning) to narrow the intention–behaviour gap.

This study tried to shed light on the following questions: (a) are social-cognitive variables able to predict intention to perform skin protection measures according to the three models’ formulations? (b) Can the three theories be applied to the prediction of actual skin protection behaviour once the individual has returned to work? (c) What are the strengths and weaknesses of each model (TPB, PWM and HAPA) when applied to skin protection behaviour in individuals with OSD and how can they individually and together inform interventions aimed at improving skin protection behaviour in these individuals?

Methods

Participants and procedure

The study was approved by the ethics committee of the University of Heidelberg (S-051-2008). All participants provided written informed consent after having received in print a comprehensive explanation of the study’s goals.

Between March 2008 and April 2009, 150 individuals with OSD completed questionnaires at admission (T0) of a 3-week inpatient tertiary individual prevention programme (TIP), at discharge 3 weeks later (T1) and again once the individual had returned to work and continuously worked for a consecutive period of 4 weeks (T2). 117 (78%) individuals were followed up at T2. TIP-participation is offered to individuals for whom primary and secondary prevention measures have not been sufficient. The concept TIP represents the final stage in a hierarchical prevention concept made available to employees by the statutory German Social Accident Insurance (Skudlik et al., 2008). They are aimed at helping afflicted individuals to remain in the workforce. Participation is voluntary, but patients are obliged
to co-operate with the respective insurance organisations in order not to lose their compensation claim. For this reason, the sample can be considered largely representative of the population of individuals with OSD in Germany.

Between admission and discharge, they underwent advanced medical assessment and therapy and simultaneously attended a variety of health-educational modules providing in-depth knowledge on all relevant aspects of OSD (types of OSD, aetiology, course, treatment) and individual skin protection behaviour. In nine health-psychological modules, patients learn how psychological mechanisms influence the success of skin protection behaviour. These theory-based modules seek to foster better stress management skills, enhance self-assertiveness, help individuals form favourable attitudes towards skin protection measures, identify barriers and resources, promote planning and prevent (health-behaviour) relapse. The intervention and the sample are explained in detail elsewhere (Matterne et al., 2009).

**Measures**

The questionnaires were developed by elicitation interviews ($n=10$), a pre-test ($n=17$), expert discussions and a literature review. All scales were 7-point Likert-scales, unless stated otherwise. If necessary, continuous measures were transformed into 1–7 scales. Total scale scores were computed by adding the respective items of that scale and dividing that sum by the number of items forming the scale.

**TPB variables**

The TPB measures were developed based on Ajzen’s (2002, revised 2006) guidelines. Attitudes were assessed by 10 semantic differentials (e.g. helpful – not helpful or pleasant – unpleasant) to the stem ‘Regular skin protection measures are…’. Subjective norm (= perceived acceptability of the behaviour) (SN) was measured by eight items (e.g. ‘Most people who are important to me think I should adhere to regular skin protection measures’). PBC was measured by 10 items (e.g. ‘Even when finding it difficult I still adhere to skin protection measures’. Descriptive norm (=perceived prevalence) (DN) (Rivis & Sheeran, 2003a; Sheeran & Orbell, 1999) was assessed as an extension to the classical TPB by one item on a 0–100% scale and asked how many per cent of individuals with OSD perform skin protection measures regularly. Intention was measured by two items to tap both expectation and likelihood aspects (Warshaw & Davis, 1985). Attitudes, SN, PBC, DN and intention were assessed at $T_0$. Skin protection behaviour (assessed at $T_2$) was measured by seven items on a scale from 1–7 assessing extent and regularity of skin protection measures in the workplace and at home. The seven items were derived in a consensus meeting with three occupational dermatologists, a health scientist and two health psychologists. They inquired about extent and frequency of the use of skin care and skin protection creams, protective gloves, adequate hand washing and avoidance of irritants and allergens. Past behaviour was assessed by the question: ‘Have you engaged in skin protection behaviour in the past?’. It offered three answer options: no, occasionally and regularly.
Prototype-willingness model

Behavioural willingness (the likelihood of a particular behaviour, here skin protection behaviour, being performed given a particular opportunity) (Gerrard et al., 2008; Gibbons et al., 1998) was operationalised by one item: ‘When the situation arises, and all I need in order to carry out all necessary skin protection measures is available, I would be willing to perform skin protection behaviour.’ Two types of prototype-perception were assessed, prototype-evaluation and prototype-similarity. First, respondents were given a brief description of what a prototype in general is and were then requested to imagine a typical person regularly engaging in skin protection measures (adapted from Gibbons, Gerrard, & McCoy, 1995) and to rate such a person on a scale from 0% (extremely negative) to 100% (extremely positive). Prototype-similarity was measured by ‘How similar do you see yourself to such a person, who regularly performs skin protection measures’ (not at all similar – very similar). Attitudes, norms, intention and behaviour were the same as for the TPB. All variables apart from behaviour (T2) were assessed at T0.

Health action process approach

Risk perceptions were assessed by five items measuring the vulnerability and the severity component. Positive OEs were measured by three items and negative OEs by two items to the stem ‘If I perform skin protection measures regularly . . .’ on 7-point Likert scales (completely disagree–completely agree). An example of a positive OE is ‘. . . my skin condition will improve’ and of a negative OE ‘. . . I will not be able to manage my work properly’. SE was measured in the form of task (four items), coping (five items) and recovery (one item) SE. These measures were based on recommendations (Schwarzer et al., 2003) and the elicitation stage. Action planning was measured by the item ‘I have a detailed plan for carrying out my personal skin protection measures’. Coping planning was assessed by the item ‘Should my normal plan be threatened I have another detailed plan for dealing with that situation’. The planning items were adapted from Schwarzer et al. (2003), Sniehotta et al. (2005) and Sniehotta (2009).

Risk perceptions, positive and negative OEs, task and coping SE and intention were assessed at T0. Recovery SE and action and coping planning were measured at T1 while skin protection behaviour was measured at T2.

Data analysis

Statistical analyses were carried out using SPSS 18 and AMOS 17. Descriptive statistics report the mean, standard deviation and range of the scales used. Path analysis using full information maximum likelihood (FIML) estimation was used to assess the longitudinal associations among the variables. Probabilities were calculated by bootstrapping (2000 samples). This would allow a greater confidence in accepting or rejecting individual model propositions (West, Finch, & Curran, 1995), particularly as we observed some violations of assumptions of regression (skewness). Model fit was assessed by examining the comparative fit index (CFI), the root-mean-square error of approximation (RMSEA) and the \( \chi^2 \) to degree of freedom (df) ratio. A model is said to have a good fit if CFI > 0.90, RMSEA < 0.08 and the \( \chi^2 \)/df is between 1 and 2 (Hu & Bentler, 1995; Tabachnik & Fidel, 2007, pp. 715–720).
There appears to be a considerable amount of variation regarding individual model specifications across studies. This study specified the tested models according to the TPB as suggested by Ajzen (1991) with the addition of DN, the PWM as delineated by Gerrard, Gibbons, Stock, Vande Lune, and Cleveland (2005) and HAPA as put forward by Schwarzer (2008a). Explorative post-hoc modifications were carried out if model fit was unsatisfactory.

Results

Missing values

Missing data analyses (0–4%) revealed that missing values were not distributed completely at random (Little’s missing completely at random (MCAR) test: \( p = 0.01 \)). Missing values were imputed by using all available variables for the estimation of missing values using an expectation maximisation algorithm based on maximum likelihood estimation. While AMOS offers FIML estimation, boot-strapping cannot be performed when there are missing values in the data set; that is why missing data were imputed prior to the analyses.

Sample description and drop-out analyses

Of the 150 individuals recruited, 60.7% were male. The mean age was 44.1 years (SD = 12.5). Eight individuals reported no previous skin protection behaviour, 47 to occasionally engage in such behaviour and 98 to regularly apply skin protection measures. When comparing individuals for whom data were available at \( T_2 \) (117 = 78%) with those who could not be followed up at \( T_2 \) (33 = 22%), no significant differences emerged in gender (\( \chi^2 = 0.17, p = 0.69 \)), age (\( t = -0.17, p = 0.86 \)) and social-cognitive variables (all \( ps \geq 0.22 \)).

Descriptive statistics and correlations among the variables under study

Most social-cognitive variables within the three models were skewed towards the right (Skewness\(_{all} < 2.10\); Kurtosis\(_{all} < 3.30\)). The notable exception was \( T_1\)-coping planning (Table 1). Internal consistency coefficients were in the range from 0.61 to 0.90. Correlations of the predictors within each model with intention were generally higher than with behaviour. Intention was consistently associated with all TPB and PWM variables apart from prototype-evaluation. Neither norm constructs nor prototype-evaluation was significantly associated with \( T_2\)-behaviour. Of the HAPA predictors of intention, all variables but risk perception and \( T_1\)-coping planning were significantly associated with intention. All HAPA variables apart from risk perception, negative OEs, \( T_1\)-recovery SE and \( T_1\)-coping planning were significantly correlated with \( T_2\)-behaviour. A significant correlation was found between past behaviour and skin protection behaviour 4 weeks after having returned to work. The correlations among the variables are given in Table 2.

Path analyses

Theory of planned behaviour

The hypothesised model fit the data well (Figure 1). SN failed to have a significant influence on intention. Attitude, DN and PBC emerged as significant predictors
of intention. PBC and intention also emerged as significant predictors of T2-skin protection behaviour; 38% of the variance in intention and 30% in behaviour were accounted for by their respective predictors. Some of the effects of attitude (standardised indirect effect coefficient ($\beta_{\text{indirect}} = 0.083$, $p = 0.031$), DN ($\beta_{\text{indirect}} = 0.078$, $p = 0.013$) and PBC ($\beta_{\text{indirect}} = 0.183$, $p = 0.002$) on behaviour were mediated by intention.

Prototype-willingness model

The obtained model fit indices were satisfactory (Figure 2). Attitude and DN but not SN significantly predicted intention. Attitude and prototype-similarity but not evaluation contributed significantly to the prediction of behavioural willingness. Intention but not willingness was a significant predictor of behaviour. The effects of the latter on behaviour were partially mediated by intention ($\beta_{\text{indirect}}$ of willingness = 0.170, $p = 0.001$); 36% of variance in intention, 30% in behaviour and 17% in behavioural willingness were explained by the respective combination of predictors.

Table 1. Means, standard deviations, range and Cronbach’s $\alpha$ of the scales or items, respectively, used in the investigation ($T0$ and $T1$: $n = 150$; $T2 = n = 117$).

<table>
<thead>
<tr>
<th>Number of items</th>
<th>$M$ (SD)</th>
<th>Range</th>
<th>Cronbach’s $\alpha$</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>TPB</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$T0$-Attitudea</td>
<td>10</td>
<td>6.02 (0.95)</td>
<td>2.10–7.00</td>
</tr>
<tr>
<td>$T0$-SNa</td>
<td>8</td>
<td>5.48 (1.36)</td>
<td>1.00–7.00</td>
</tr>
<tr>
<td>$T0$-PBCa</td>
<td>11</td>
<td>5.58 (0.80)</td>
<td>2.91–7.00</td>
</tr>
<tr>
<td>$T0$-DNb</td>
<td>1</td>
<td>45.14 (22.92)</td>
<td>0–100%</td>
</tr>
<tr>
<td><strong>PWM</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$T0$-Behavioural willingnessa</td>
<td>1</td>
<td>6.43 (0.98)</td>
<td>2.00–7.00</td>
</tr>
<tr>
<td>$T0$-Prototype-similaritya</td>
<td>1</td>
<td>5.17 (1.44)</td>
<td>1.00–7.00</td>
</tr>
<tr>
<td>$T0$-Prototype-evaluationb</td>
<td>1</td>
<td>72.46 (21.52)</td>
<td>0–100%</td>
</tr>
<tr>
<td><strong>HAPA</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$T0$-Vulnerability absoluteb</td>
<td>1</td>
<td>58.41 (27.44)</td>
<td>0–100%</td>
</tr>
<tr>
<td>$T0$-Vulnerability relativea</td>
<td>1</td>
<td>4.43 (1.60)</td>
<td>1.00–7.00</td>
</tr>
<tr>
<td>$T0$-Severitya</td>
<td>3</td>
<td>5.78 (1.41)</td>
<td>1.00–7.00</td>
</tr>
<tr>
<td>$T0$-Risk totala</td>
<td>5</td>
<td>5.13 (1.05)</td>
<td>2.03–7.00</td>
</tr>
<tr>
<td>$T0$-Positive OEa</td>
<td>3</td>
<td>5.81 (1.12)</td>
<td>1.67–7.00</td>
</tr>
<tr>
<td>$T0$-Negative OEa</td>
<td>2</td>
<td>2.87 (1.54)</td>
<td>1.00–7.00</td>
</tr>
<tr>
<td>$T0$-Task self-efficacya</td>
<td>4</td>
<td>5.98 (0.92)</td>
<td>2.80–7.00</td>
</tr>
<tr>
<td>$T0$-Coping self-efficacya</td>
<td>5</td>
<td>5.83 (0.97)</td>
<td>3.00–7.00</td>
</tr>
<tr>
<td>$T1$-Recovery self-efficacya</td>
<td>1</td>
<td>6.33 (1.25)</td>
<td>1.00–7.00</td>
</tr>
<tr>
<td>$T1$-Action planninga</td>
<td>1</td>
<td>5.24 (1.75)</td>
<td>1.00–7.00</td>
</tr>
<tr>
<td>$T1$-Coping planninga</td>
<td>1</td>
<td>3.50 (1.91)</td>
<td>1.00–7.00</td>
</tr>
<tr>
<td><strong>All models</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$T0$-Intentiona,c</td>
<td>2</td>
<td>6.30 (0.74)</td>
<td>3.40–7.00</td>
</tr>
<tr>
<td>$T2$-Behavioura</td>
<td>7</td>
<td>6.53 (0.52)</td>
<td>1.00–7.00</td>
</tr>
</tbody>
</table>

Notes: TPB, theory of planned behaviour; PWM, prototype-willingness model; HAPA, health action process approach; SN, subjective norm; PBC, perceived behavioural control; DN, descriptive norm; OE, outcome expectancies; n.a., not applicable.

Scaling: $a1–7$; $b0–100$%; $ca$ alpha based on composite with items based on $p < 0.001$. 

Psychology and Health
Table 2. Intercorrelations among the variables within the TPB, PWM and HAPA (T0 and T1: n = 150; T2 = n = 117).

<table>
<thead>
<tr>
<th>TPB and PWM</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. T0-Attitude</td>
<td>0.29***</td>
<td>0.47***</td>
<td>0.05</td>
<td>0.34***</td>
<td>0.27**</td>
<td>0.23**</td>
<td>0.43***</td>
<td>0.26**</td>
<td></td>
</tr>
<tr>
<td>2. T0-SN</td>
<td>0.33***</td>
<td>-0.01</td>
<td>0.20*</td>
<td>0.10</td>
<td>0.29***</td>
<td>0.24**</td>
<td>0.12</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. T0-PBC</td>
<td>0.06</td>
<td>0.42***</td>
<td>0.32***</td>
<td>0.20*</td>
<td>0.56***</td>
<td>0.41***</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. T0-DN</td>
<td>0.06</td>
<td>0.12</td>
<td>0.10</td>
<td>0.22**</td>
<td>0.03</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. T0-Willingness</td>
<td>0.29***</td>
<td>0.15</td>
<td>0.50***</td>
<td>0.36***</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. T0-Prototype-similarity</td>
<td>0.15</td>
<td>0.15</td>
<td>0.39***</td>
<td>0.39***</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7. T0-Prototype-evaluation</td>
<td>0.14</td>
<td>0.14</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8. T0-Intention</td>
<td>0.49***</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9. T2-Behaviour</td>
<td>0.21*</td>
<td></td>
<td></td>
<td></td>
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<td>10. T0-Past behaviour</td>
<td>0.21*</td>
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HAPA

| 1. T0-Risk perception | -0.10 | -0.06 | -0.09 | -0.01 | -0.07 | 0.06 | -0.02 | 0.06 | -0.11 |
| 2. T0-Positive OE | -0.15 | 0.44*** | 0.34*** | 0.06 | 0.18* | 0.15 | 0.25** | 0.32*** |
| 3. T0-Negative OE | -0.21* | -0.41*** | 0.03 | -0.13 | -0.12 | -0.26** | -0.15 |
| 4. T0-Task SE | 0.57*** | 0.13 | 0.39*** | 0.12 | 0.48*** | 0.47*** |
| 5. T0-Coping SE | 0.28** | 0.36*** | 0.21** | 0.52*** | 0.36*** |
| 6. T1-Recovery SE | 0.09 | 0.20* | 0.21* | 0.08 |
| 7. T1-Action planning | 0.26** | 0.43*** | 0.35** |
| 8. T1-Coping planning | 0.14 | 0.04 |
| 9. T0-Intention | 0.49*** |

Notes: TPB, theory of planned behaviour; PWM, prototype-willingness model; HAPA, health action process approach; SN, subjective norm; DN, descriptive norm; OE, outcome expectancies; SE, Self-efficacy; *p < 0.05, **p < 0.01, ***p < 0.001.
Confirmatory path analysis concerning the new HAPA model as featured in Schwarzer (2008a) provided limited support for the hypothesised model ($\chi^2 = 63.745$, $df = 25$, $p < 0.001$, $CFI = 0.813$, $RMSEA = 0.113$ (90% CI: 0.081; 0.152)).

Subjective norm ($T_0$) 0.36
Descriptive norm ($T_0$) 0.44

Intention ($T_0$) 0.42

Behaviour ($T_2$) 0.30

Prototype evaluation ($T_0$) 0.17
Prototype similarity ($T_0$) 0.29

Intention ($T_0$) 0.30

Behaviour ($T_2$) 0.33

Attitude ($T_0$) 0.29

Subjective norm ($T_0$) 0.04

Descriptive norm ($T_0$) 0.38

PBC ($T_0$)

Health action process approach

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Descriptive norm ($T_0$) 0.38

PBC ($T_0$)
Modification indices (MI) suggested correlating the SE constructs rather than task-SE to predict coping-SE which in turn predicts recovery-SE and a direct path from intention to behaviour. The model was significantly improved \( \chi^2(12, n=117) = 51.093, p < 0.001 \), and it fit the data well (Figure 3). The main difference to the hypothesised model was that \( T_0 \)-task and \( T_0 \)-coping SE significantly predicted intention. \( T_1 \)-recovery SE did not predict behaviour. Task but not coping SE had a direct effect on action planning. Coping planning was neither predicted by any of the variables nor did it significantly mediate the effects of other variables in the model nor was it a significant predictor of behaviour itself. A strong and significant path from intention to skin protection behaviour emerged in this model. Of the SE constructs, only task SE had a significant direct path to behaviour. Neither action nor coping planning contributed significantly to the prediction of behaviour once intention was allowed as a direct predictor of behaviour. The effects of task and coping SE on behaviour were partially mediated by intention (task SE: \( \beta_{\text{indirect}} = 0.113, p = 0.024 \); coping SE: \( \beta_{\text{indirect}} = 0.084, p = 0.041 \)). Neither positive nor negative OEs nor risk perception significantly predicted intention. In this study, 33% of the variance in intention, 29% in action planning and 33% in skin protection behaviour were accounted for by the respective joint variables.

**Past behaviour**

Finally, to assess whether there was any residual impact of past behaviour on skin protection behaviour beyond the models’ variables (Ajzen, 2002b), all three models...
Discussion
This study found no significant effect of past behaviour on future behaviour beyond the effects of the three theories’ variables, suggesting that the influence of past behaviour on future behaviour is mediated by the social-cognitive variables of the respective theory.

Theory of planned behaviour
Most predictions of the TPB (Ajzen, 1991, 2002a) held when applied to a tertiary prevention setting with occupationally relevant skin protection behaviour as the primary outcome. PBC followed by attitude were the most important predictors of intention. Although attitude typically appears the strongest predictor of intention, followed by PBC and SN (Fife-Schaw, Sheeran, & Norman, 2007), there are other studies finding PBC (Armitage, 2005; Foley et al., 2008) or constructs other than attitude or PBC (Conner et al., 2007; Rise, Kovac, Kraft, & Moan, 2008) the strongest predictor of intention. Depending on the behaviour in question, the strength of individual predictors of intention may vary (Ajzen, 1991; Smith-McLallen & Fishbein, 2008).

SN was not a significant predictor of behavioural intention and has been considered a weak predictor within the TPB (Armitage & Conner, 2001) while Sheeran and Orbell (1999) argue that attitude and PBC are more important in shaping intention. DN appeared a significant predictor of intention. Although an influence of social norms on people’s behaviour via preceding intention is now established, particularly when measured as the separate constructs subjective and DN (Goldstein & Cialdini, 2007), this study produced only partial evidence for normative influences to predict behavioural intention to perform skin protection measures. In line with previous research studying a variety of health behaviours (Blanchard, Courneya, Rodgers, Daub, & Knapik, 2002; Blanchard et al., 2009; Conner et al., 2007) was the finding of intention to be the strongest predictor of skin protection behaviour followed by PBC.

Prototype-willingness model
Although the authors originally developed the PWM (Gerrard et al., 2008; Gibbons et al., 1998; Gibbons et al., 2009) with risk behaviour as the target behaviour and adolescents as the target group in mind, its more universal applicability (e.g. prevention behaviour and individuals other than adolescents) has also been admitted (Gibbons, Gerrard, & Lane, 2003). We found only limited evidence for the prototype-approach to be a useful concept in explaining skin protection behaviour in individuals with OSD. Although intention was significantly predicted by attitude,
DN and behavioural willingness as suggested by the model only prototype-similarity but not evaluation contributed significantly to the prediction of behavioural willingness. The item measuring prototype-evaluation may have been too general and thus failed to assess patients' association with their typical prototype. Other studies (Norman, Armitage, & Quigley, 2007; Rivis & Sheeran, 2003b; Rivis et al., 2006) found prototype-similarity the more consistent predictor of intention in comparison to prototype-evaluation. The data from this study do not support the notion of the social reaction path (via behavioural willingness) to directly predict skin protection behaviour. Rather, the effect of the generic PWM construct behavioural willingness on behaviour was partially mediated by behavioural intention. Studies producing evidence for prototype-perceptions and behavioural willingness to be predictive of behaviour often only look at the social reaction path e.g. (Gerrard et al., 2002; Gerrard et al., 2005; Gibbons et al., 1998), while this study simultaneously tested both the reasoned as well as the social reaction path.

**Health action process approach**

In contrast to the TPB and PWM which mainly focus on motivational and social factors in the prediction of behaviour, HAPA (Schwarzer, 2008a) also places a strong emphasis on volitional processes, such as planning (Sniehotta, 2009) in the formation of health behaviour (change) in order to bridge the often observed intention–behaviour gap (e.g. Cooke & Sheeran, 2004; Orbell & Sheeran, 1998; Sheeran, 2002). Unfortunately, we failed to provide good data supporting this aspect of the theory. Model fit indices suggested rejection of the model according to Schwarzer (2008a). In a modified model a substantial amount of variation in action planning was explained by task SE and intention. However, neither action nor coping planning was predictive of behaviour in the modified model. While this finding is disappointing, we do not think that planning is not important. Perhaps plans developed during TIP may not be relevant once the individual returns to work or they were not specific enough to apply in a complex work setting. In addition, the planning items were only assessed by single items giving rise to concerns about their reliability and validity. These questions need to be addressed in future studies.

The results of this study are, however, in line with other predictions of the model. Task and coping SE turned out to be significant predictors of intention. Risk perception and positive and negative OE, however, failed to significantly predict intention. Previous research has produced inconsistent results regarding the role of risk perceptions in the formation of behavioural intention. Three of four recent studies by Schwarzer et al. (2007), a study by Scholz, Schütz, Ziegelmann, Lippke, and Schwarzer (2008) and one study by Luszczynska and Schwarzer (2003) failed to find a significant influence of risk perception on intention. Another three studies by Schwarzer et al. (2008) found risk perception once a significant positive, once a marginally significant but negative and once no significant predictor of behavioural intention. First, for some types of behaviour, risk perception may be important in shaping intentions while for others it may not. Second, risk perceptions may only be influential at early stages of behavioural change (Schwarzer & Renner, 2000). In individuals with OSD, risk perceptions appear to play a negligible role in the prediction of their intention to perform skin protection behaviour.
Although many studies have reported higher positive and lower negative OEs to be associated with the magnitude of intention (e.g. Garcia & Mann, 2003; Luszczynska & Schwarzer, 2003; Schwarzer et al., 2007; Schwarzer et al., 2008), there are also studies failing to find OEs to be significant predictors of intention (Renner et al., 2008; Scholz et al., 2008) or finding them a significant predictor only in subgroups of the studied samples (Renner, Spivak, Kwon, & Schwarzer, 2007). The impact they have on intention formation appears to be subject to variation.

Model comparison
The TPB and PWM explained similar amounts of variance in intention and behaviour while HAPA explained a little less in intention but more in behaviour. The amounts of variance explained by TPB variables were similar to meta-analytic findings (Armitage & Conner, 2001). Studies testing the full HAPA usually find the amount of explained variance in the range of 14% (Schwarzer et al., 2008 (study 1)) to 73% (Schwarzer et al., 2007 (study 3)).

In terms of parameter estimates being consistent with the theory, our data were not able to confirm all predictions. For instance, in the TPB SN failed to have a significant path to intention, in the PWM the social reaction path was not fully supported by the data while in HAPA important predictors of intention could not be replicated, aspects of phase-specific SE were not in line with predictions and planning was neither predictive of behaviour nor mediating the effects of intention or SE on behaviour. All three models fit the data satisfactorily though HAPA had to be modified. However, measurement of some constructs was not optimal (see limitations).

In an effort to integrate this study’s findings, it can be concluded that all three models are able to inform us about the formation of skin protection intention and behaviour in individuals with OSD. Each one has different strengths and weaknesses. The TPB is a parsimonious model which perhaps oversimplifies the processes that produce health behaviour (Armitage & Conner, 2000). The PWM with its strong focus on social reaction processes offers valuable additions to the reasoned path to behaviour via intention. However, many studies tested the social reaction path alone, rather than looking at the independent contribution of each path to the prediction of intention and behaviour. We tested both and found an influence of prototype similarity on willingness, which in turn significantly predicted intention.

HAPA also includes self-regulatory processes assumed to be of importance, once an intention has been formed in an attempt to narrow the often observed intention–behaviour gap. The recently added view on phase-specific SE adds further complexity to the model. Both are major advantages as they can help explain more variance in intention and behaviour. In practice, tests of HAPA have consisted of a variety of model specifications and even when adhering closely to the hypothesised model individual model parameters varied widely depending on the sample or the specific behaviour under investigation.

Limitations
Only 117 (78%) of the original 150 patients that were assessed at T0 and T1 were followed up at T2. However, drop-out analyses revealed no significant differences in demographic characteristics and social-cognitive variables. A further limitation...
of this study is the assessment of (skin protection) behaviour by self-report. Self-report may be subject to a variety of biases, most notably social desirability (Holtgraves, 2004). An objective measure, for instance an observation in the workplace, was no viable alternative, however. Self-report may also be subject to recall-bias or memory distortion but research suggests that accuracy is less affected the closer in time assessment takes place (Kupek, 2002). Since the recall period was only 4 weeks, this is unlikely to have happened. Future studies may want to consider the use of diaries. Further, some scales’ internal consistency’s coefficients were suboptimal. A minimum of 0.70 for Cronbach’s $\alpha$ has been suggested (Murphy & Davidshofer, 1988, p. 89). Four scales $\alpha$’s were only between 0.60 and 0.70. The sample size for modelling latent constructs with manifest variables by CFA was, however, insufficient. There were also several constructs measured by single items only. A lengthier questionnaire was not possible, however, but future studies should endeavour to obtain multiple-item measures. Nevertheless, as long as single items are clear, possess face validity and are easy to understand by respondents, they can be included in analyses (Helgeson, 1992). While most predictions of the three theories were confirmed by the data, a larger sample size may have increased our confidence in the robustness of the observed findings. Although ceiling tendencies were observed in some variables, there was variability in these variables and the skewness values were not so bad as to invalidate the results of the analyses (Tabachnik & Fidel, 2007, p. 80). Nevertheless, the scope for potential correlations among such measures is reduced.

Suggestions for future research and implications for practice

As each tested model had unique concepts being predictive of intention or behaviour, future studies could test combinations of the TPB, PWM and HAPA to predict skin protection behaviour in individuals with OSD. For instance, one such model could contain attitude, social norms, prototype variables and phase-specific SE. It could also be tested whether more elaborately measured plans mediate these variables’ effects on behaviour.

The findings from this study suggest that interventions aiming to improve skin protection behaviour in individuals with OSD should place a strong focus on the development of favourable attitudes, perceptions of a high prevalence of skin protection behaviour (DN), prototypes one can easily identify with, and high behavioural control/SE. While planning was not found to mediate the effects of these variables on behaviour in this study, plans may nevertheless be found important if measured more elaborately and specific to the individuals’ working context. Risk perceptions on the other hand appeared to have a negligible influence. The finding of behavioural willingness to contribute to the prediction of intention suggests that organisations should provide everything that is necessary for optimal skin protection measures. Individuals ought to, however, also learn that should these opportunities not be provided it is up to them to provide them themselves or insist on their provision. These are behaviours, however, which also depend on favourable social cognitions.

Conclusions

This study sought to contribute to research in the field of health psychology by examining the role of social-cognitive factors in the formation of occupationally
relevant skin protection behaviour in individuals with OSD. The findings from this
study make a substantial contribution to the literature because health behaviour
theory was applied to a specific tertiary prevention setting for the first time and
second, because three theories were examined simultaneously.

References


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