Mental Toughness as a Moderator of the Intention-Behaviour Gap in the Rehabilitation of Knee Pain

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Abstract

Objectives: The purpose of this study was to investigate the role of mental toughness in maximising the effect of intentions to perform rehabilitative exercises on behaviour among a sample of people with knee pain.

Design: Cross-sectional survey, with a 2-week time-lagged assessment of exercise behaviour.

Methods: In total, 193 individuals (n_{female} = 107, n_{male} = 84) aged between 18 and 69 years (M = 30.79, SD = 9.39) participated, with 136 (70.5%) retained at both assessment points. At time 1, participants completed an online, multisection survey that encompassed measures of demographic details, severity of problems associated with the knee (e.g., pain, symptoms), past behaviour, mental toughness, and the theory of planned behaviour constructs (TPB; attitudes, subjective norms, perceived behavioural, intentions). Two weeks later, participants retrospectively reported their exercise behaviour for the past 14 days using an online survey.

Results: Moderated regression analyses indicated that mental toughness and its interaction with intention accounted for an additional 3% and 4% of the variance in exercise behaviour, respectively. Past behaviour, attitudes, and mental toughness all had direct effects on behaviour, alongside a meaningful interaction between intentions and mental toughness. Specifically, intentions had a stronger effect on exercise behaviour among those individuals high in mental toughness compared to those low in this personal resource.

Conclusions: The results of this study shed new light on the intention-behaviour gap by indicating that mental toughness increases the likelihood that intention is translated into action.

Keywords: intention-behaviour gap; mentally tough; personal resource; physical activity; resource caravan; self-regulation
Introduction

Exercise – which includes general (e.g., walking) or disease-specific recommendations (e.g., muscle strengthening) regarding planned and structured bodily movements – is often prescribed for the prevention and rehabilitation of health conditions such as knee osteoarthritis\(^1\), cancer\(^2\), and stroke\(^3\). Meta-epidemiological evidence indicates that exercise is just as effective as drug therapy in the secondary prevention of coronary heart disease, treatment of heart failure and prevention of Type 2 diabetes\(^4\). Despite these well-documented benefits of exercise for health and well-being, adherence to exercise recommendations is often poor and therefore compromises the effectiveness of treatment\(^5\). Thus, there is a need to better understand those factors that maximise peoples’ engagement in exercise for rehabilitative and proactive purposes.

A diverse range of psychological, behavioural, environmental and social factors are important for the initiation and maintenance of health behaviours\(^6\). As theory-based interventions are more effective than atheoretical approaches\(^7\), considerable work has been devoted to developing and testing theoretical explanations for health behaviours. Social-cognitive theories have received widespread attention as a backdrop upon which to better understand individual-level determinants of behaviour. With regard to exercise, the theory of planned behaviour (TPB\(^8\)) is one of the most widely adopted frameworks. Within the context of the TPB, one’s intention to engage in the target behaviour is the primary determinant of whether or not one enacts the behaviour. Intention reflects the degree to which one is willing or ready to engage in the behaviour, and the amount of effort they plan to exert towards it. In turn, there are three distal cognitive and affective processes by which individuals form intentions to enact behaviour: attitudes refer to one’s overall evaluation of the experiential (affective) aspects and outcomes (instrumental) of the behaviour; subjective norms reflect one’s perceptions of social pressure from significant others to perform or not carry out the
behaviour; and perceived behavioural control captures one’s beliefs regarding the ease or
difficulty with which the behaviour can be executed. The usefulness of the TPB for
explaining a range of health behaviours including exercise is supported by meta-analytic
evidence⁹.

Intentions are clearly important for exercise behaviour¹⁰, yet there is a noticeable
‘gap’ in that good intentions do not always translate into action¹¹. Accordingly, considerable
effort has been directed towards clarifying our understanding of variables that may moderate
this association. There is a large body of work that has focused on post-intentional, self-
regulatory strategies such as action and coping planning as a means by which to translate
exercise intentions into behaviour¹². Meta-analytic evidence indicates that these self-
regulatory techniques are effective processes by which to translate physical activity intentions
into behaviour¹³. Despite the benefits of these self-regulatory techniques for bridging the
intention-behaviour gap, adherence to these strategies are modest¹⁴. An alternative yet
complementary approach is to examine personal resources that capture individual differences
in peoples’ existing self-regulatory capacity.

Learning about individual differences that may foster or forestall purposeful processes
designed to regulate thoughts, emotions and behaviours is likely to generate new insights into
the intention-behaviour relation. Representing one such personal resource, mental toughness
refers to a psychological capacity to attain and sustain one’s self-referenced standards or
objectives (e.g., goals, performance) despite varying degrees of situational demands¹⁵. Since
perseverance is a key behavioural signature of mentally tough individuals¹⁶,¹⁷, there is reason
to believe that this personal resource may foster the translation of intentions into behaviour.

For example, research has shown that individuals who self-report high levels of mental
toughness are more likely to produce higher levels of work performance, achieve more
progress towards academic and social goals over a university semester, and withstand
multiple and accumulating stressors over a 6-week period to succeed in their goal to pass a
selection test\textsuperscript{15}. Qualitative work indicates that mentally tough individuals identify, evaluate
and re-assess goals\textsuperscript{18}, and use long-term goals as a source of motivation\textsuperscript{19}. Mental toughness
is therefore one potentially important source of individuality that may underpin the effective
regulation of thoughts, emotions and behaviours or the application of self-regulatory
strategies in the pursuit of volitional behaviours like exercise rehabilitation.

The purpose of this study was to test whether or not mental toughness can bridge the
intention-behaviour gap. As mental toughness is a personal resource that fosters behavioural
perseverance on a task\textsuperscript{17} and therefore facilitates positive outcomes for volitional behaviour\textsuperscript{15},
it is expected to moderate the intention-behaviour association such that the strength of the
relation will be greatest for people with high levels of mental toughness when compared with
low levels of this personal resource. As the TPB is most pertinent when behaviour is
volitional (i.e., driven by the will or intent of an individual to perform some action\textsuperscript{8}), the
focus in this study is on people with knee pain who have been prescribed rehabilitative
exercises by a physiotherapist. Although the home-based rehabilitation exercises have been
prescribed by a physiotherapist, it is up to individuals as to whether or not they execute these
behaviours according to the professional advice. The TPB has been used extensively to study
a wide variety of health behaviours, yet there have been few applications of this theoretical
framework in people with knee pain. Thus, this study also provided an opportunity to test the
robustness of key theoretical expectations of the TPB.

Methods

A total of 193 individuals ($n_{\text{female}} = 107$, $n_{\text{male}} = 84$) aged between 18 and 69 years ($M$
$= 30.79$, $SD = 9.39$) participated in this study. Of the 193 participants who started the study,
136 (70.5\%) completed both assessment points. People who met the following criteria were
eligible to participate: in the past month, experienced (i) knee pain accompanied by morning
stiffness lasting less than 30 minutes, (ii) crepitus on active movements, (iii) tenderness of the bony margins of the knee joint, and (iv) had consulted a physiotherapist about their knee pain and therefore had been provided with information regarding specific rehabilitative exercises. Participants were excluded if they had ever experienced a cardiac event (e.g., heart attack), had major bone or joint surgery (e.g., ACL), or a BMI greater than 35. Demographic data were collected by self-report and included age, gender, height, and weight. The subscales of pain, symptoms and function in activities in daily living from the Knee Injury and Osteoarthritis Outcome Score provided an assessment of the severity of problems associated with the knee. Mental toughness was assessed using an established 8-item inventory. Items designed to capture the theory of planned behaviour variables were developed in accordance with Azjen’s guidelines (see Appendix A of the Supplementary Material). TPB instruments that have been developed in accordance with these guidelines have demonstrated excellent reliability and validity in previous research. Consistent with the approach used in previous research, exercise behaviour was assessed using a self-report measure in which participants indicated the frequency of rehabilitative exercises performed on average for 30 minutes over the past two weeks. In this study, rehabilitative exercises were defined as those activities that are intended to reduce the amount of pain experienced and/or strengthen those muscles that support the knee and surrounding areas with the view of preventing future knee pain.

All study procedures were approved by [name blinded for peer-review] human research ethics committee. Participants were recruited and completed the study anonymously online via SocialSci (www.socialsci.com). Potential participants were recruited to this platform via online advertising, print media, and live recruitment where they signed up to take part in academic research in return for small points-based Amazon credits. The first section of the survey contained measures to ascertain an individual’s eligibility for the study.
Eligible and consenting participants subsequently provided demographic details and completed measures of the TPB, severity of problems associated with knee pain, mental toughness, and their intended exercise behaviour over the preceding 14 days. Two weeks later participants provided a self-report of their exercise behaviour over the preceding 14 days.

Data was initially screened for violations of assumptions of normality and outliers. First, to examine the possibility of an attrition bias, an analysis of variance (ANOVA) was performed to test for differences in the study variables at time 1 between those participants who completed the time 2 survey and those who did not respond, whereas a chi-square ($\chi^2$) analysis was performed for gender (see Table 1). Second, a hierarchical multiple regression was performed to assess the effects of the distal predictors of intentions. Covariates were entered at Step 1 (demographic factors, severity of knee problems, and past behaviour), with attitudes, subjective norms and perceived behavioural control added at Step 2. Third, a moderated hierarchical multiple regression was performed to assess the importance of social-cognitive factors and mental toughness as determinants of exercise behaviour, while controlling for covariates. All independent variables were standardised prior to the regression analyses; gender was dummy coded (0 = female, 1 = male). Covariates were entered at Step 1; the TPB variables were entered at Step 2; mental toughness was entered at Step 3; and the interaction between mental toughness and intentions was entered at Step 4. This approach permitted an examination of the incremental validity of mental toughness, and its interaction. Simple slopes analyses of the interaction effect were plotted and tested at one standard deviation above and below the mean, and at the mean of mental toughness.$^{26}$

**Results**

Data screening revealed no violations against assumptions of multivariate outliers (i.e., using a $p < .001$ criterion for Mahalanobis $D^2$), skewness (all variables $< \pm 1.3$), and
kurtosis (all variables < ± 3.6) for subscales of all study variables. However, seven univariate outliers were identified with regard to the psycho-social variables (i.e., z score > ± 3.29). As the exclusion of these outliers did not alter the results of the main analyses, they were retained for all analyses and the reported findings. Bivariate correlations among study variables and internal reliability estimates of self-reported severity of knee problems, mental toughness and the TPB are provided in Appendix B of the Supplementary Material. All measures demonstrated adequate levels of internal reliability. An overview of the ANOVA summary statistics is detailed in Table 1. Participants who responded at both time points did not differ from those individuals who dropped out of the study. With regard to gender, females (n = 39; 36.4%) were more likely than males (n = 18; 21.4%) to drop out of the study, χ = 5.95, p = .051.

The control variables accounted for 12% of the variance in intention, F (7, 128) = 2.56, p = .017, η² = .129, 90% CI = .012, .171 (see Steiger27 for an explanation of the use of 90% confidence intervals for eta squared). Only past behaviour was a meaningful determinant of intention (B = .31, 95% CI = .13, .49, p = .001). The inclusion of the TPB distal predictors of intentions accounted for an additional 27% of the variance, F (3, 125) = 18.56, p < .001, η² = .308, 90% CI = .188, .393. Past behaviour (B = .24, 95% CI = .09, .39, p = .002), attitudes (B = .30, 95% CI = .15, .46, p < .001) and perceived behavioural control (B = .30, 95% CI = .14, .45, p < .001), but not subjective norms (B = .10, 95% CI = -.06, .27, p = .223), were important determinants of intention.

With regard to the prediction of exercise behaviour, at Step 1 of the moderated regression, the control variables accounted for 15% of the variance in exercise behaviour, F (7, 128) = 3.16, p = .004, η² = .147, 90% CI = .029, .201. There was a significant effect for past behaviour (B = 1.30, 95% CI = .67, 1.93, p < .001). The inclusion of the TPB variables to the model at Step 2 accounted for an additional 11% of the variance in exercise behaviour,
TPB and mental toughness

There were significant effects for past behaviour (B = .90, 95% CI = .27, 1.54, p = .006) and intentions (B = .86, 95% CI = .17, 1.60, p = .015). The inclusion of mental toughness at Step 3 indicated that the main effect (B = .72, 95% CI = .11, 1.33, p = .022) accounted for an additional 3% of the variance in exercise behaviour, $F(1, 123) = 5.41$, $p = .022$, $\eta^2 = .042$, 90% CI = .003, .113. At Step 4, the inclusion of the interaction between mental toughness and intentions accounted for an additional 4% of the variance in exercise behaviour, $F(1, 122) = 6.30$, $p = .013$, $\eta^2 = .049$, 90% CI = .006, .123. There were significant effects for past behaviour, attitudes, mental toughness and the interaction between intentions and mental toughness (see Table 2). Simple slopes analyses indicated that the association between intentions and exercise behaviour was its greatest when mental toughness was high (B = 1.172, $t = 3.67$, $p < .001$), with a less amplified positive relation at moderate mental toughness (B = .50, $t = 1.379$, $p = .17$) and a slightly inverse association at low levels of mental toughness (B = -.17, $t = -.40$, $p = .69$). A visual display of the simple slopes is depicted in Figure 1.

Discussion

The purpose of this study was to investigate the role of mental toughness in maximising the effect of intentions to perform rehabilitative exercises on behaviour among a sample of people with knee pain. Overall, the findings of this study provided additional support for key theoretical expectations of the TPB in a sample of people with knee pain. In terms of unique contributions, the results of this study shed new light on the intention-behaviour gap by indicating that mental toughness increases the likelihood that intention is translated into action.

Meta-analytic reviews of prospective correlational tests of the TPB have shown that the TPB explains small and moderate amounts of variance in behaviours and intentions, respectively. As one of the first tests of the TPB in people with knee pain, the results of the
The current study provided additional support for several of these theoretical expectations. First, the TPB constructs explained over twice as much of the variance in intentions when compared with behaviour. Second, attitude and perceived behavioural control evidenced the greatest association with intentions. Third, although not amenable to change, past behaviour is a primary determinant of future behaviour. Despite these positive results, several of the current findings were incongruent with existing meta-analytic data\textsuperscript{9,10} and theoretical expectations\textsuperscript{8}. For example, the effect of intention on behaviour was attenuated by the inclusion of mental toughness and its interaction with intention. Moreover, perceived behavioural control was not directly related to exercise behaviour, even when mental toughness was excluded from the analysis. Collectively, these results strengthen claims that the efficacy of the TPB depends on the target behaviour\textsuperscript{9}, and reinforce the importance of formative research as a precursor to effective TPB-based interventions.

This study makes an important contribution to the literature by demonstrating the importance of mental toughness as a determinant of exercise behaviour. Both direct and moderating effects of mental toughness on exercise behaviour were examined and found to be meaningful. In terms of the moderation hypothesis, intentions had a stronger effect on exercise behaviour among those individuals high in mental toughness compared to those low in this personal resource. This study is the first to report such an interaction effect. As these effects were evidenced while accounting for control variables and the TPB constructs, these findings provide further evidence for the incremental validity of mental toughness over and above well-established predictors of volitional behaviours. From a practical standpoint, it is encouraging that individuals with high levels of mental toughness and intentions reported engaging in over three sessions of 30 mins per week, which is consistent with exercise recommendations for people with knee osteoarthritis\textsuperscript{28}. 
At least two possible explanations might account for the direct and moderation effects of mental toughness observed in this study. First, given that perseverance is a behavioural signature of mental toughness\textsuperscript{16,17}, it is likely that individuals with high levels of mental toughness persist longer in duration when working towards their exercise goals. Second, as a resource caravan that is central to coping processes (e.g., affective self-regulatory capabilities, ability to bounce back from setbacks)\textsuperscript{15}, mental toughness may prove beneficial in ensuring that people are able to carry out their intentions despite the presence of stressors, especially when perceived behavioural control for the target behaviour is low. Nevertheless, the inclusion of mental toughness as an additional predictor within the context of the TPB is at odds with the principle of compatibility; that is, a new variable should be behaviour-specific and therefore measured at the same level of specificity as the target behaviour or action\textsuperscript{29}. It is therefore important that these findings are replicated in future research before any definitive conclusions can be made in this regard.

**Conclusion**

This study is the first to test the moderating role of mental toughness on the intention-exercise behaviour relation. Missing from this study is an understanding of how mental toughness enables people to engage in exercise rehabilitation. For example, do individuals simply try harder and persevere? Are people less affected by stressors? There are other limitations to the current study that open up important avenues for future research. First, all study variables were measured via self-report and therefore may be influenced by common method bias. Second, despite the temporal lag in the assessment of exercise behaviour over a 2-week period, the design is not longitudinal nor experimental in nature and therefore cannot provide evidence for causality. Third, the large age range of participants in this study is both a strength (e.g., ability to generalise) and weakness, as the TPB is most predictive amongst young people\textsuperscript{9}. Finally, it is difficult to control for motivational strategies offered by
TPB and mental toughness

physiotherapists and their influence on patients in an observational, cross-sectional study that did not incorporate measures of these variables. Despite these limitations, this study offers a new insight into a personal resource that may help translate good intentions into exercise behaviour.

Practical Implications

• Mental toughness is an important personal resource that can enable people to make the most out of good intentions

• Enhancing peoples’ perceptions of control over a specific behaviour can enhance the likelihood that they will form strong intentions to engage in the behaviour

• For people with low intentions, emphasise the experiential or affective aspects (e.g., enjoyable) and instrumental outcomes (e.g., individualised benefits) of engaging in exercises for their knee pain
Acknowledgements

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References


Table 1. Overview of ANOVA summary statistics for attrition bias analyses (Note: normalised scores for symptoms, pain, and daily function).

<table>
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<th>Non-Responders (n=57)</th>
<th>Responders (n=136)</th>
<th>ANOVA (df = 1, 191)</th>
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<tr>
<td></td>
<td>M</td>
<td>SD</td>
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<tr>
<td>Age</td>
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<td>Symptoms</td>
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<td>Pain</td>
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<td>71.83, 81.19</td>
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<td>Daily function</td>
<td>85.84</td>
<td>17.48</td>
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<td>Behavioural control</td>
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<td>1.32</td>
<td>4.55, 5.25</td>
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<td>Intentions</td>
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<td>1.67</td>
<td>2.75, 3.64</td>
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<td>5.12</td>
<td>1.14</td>
<td>4.82, 5.43</td>
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<td>1.12</td>
<td>2.84</td>
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Table 2. Moderated regression (Step 4) predicting exercise behaviour from TPB variables, mental toughness, and interaction term while accounting for demographic covariates.

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<tr>
<td>Gender</td>
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<td>.56</td>
<td>-.10</td>
<td>-1.28</td>
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<tr>
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<td>-1.74</td>
<td>.39</td>
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<td>.77</td>
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<td>1.04*</td>
<td>.43</td>
<td>1.66</td>
<td>.31</td>
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<td>3.35</td>
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<td>Symptoms</td>
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<td>.39</td>
<td>.34</td>
<td>-.08</td>
<td>-.86</td>
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<td>Pain</td>
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<td>-1.11</td>
<td>1.36</td>
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<td>.03</td>
<td>.20</td>
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<td>Function</td>
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<td>-1.09</td>
<td>1.32</td>
<td>.61</td>
<td>.03</td>
<td>.18</td>
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<td>Intentions</td>
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<td>1.22</td>
<td>.36</td>
<td>.14</td>
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<td>Attitudes</td>
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<td>.07</td>
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<td>.20*</td>
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<td>Subjective norms</td>
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<td>.33</td>
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<tr>
<td>Mental toughness</td>
<td>.82*</td>
<td>.21</td>
<td>1.42</td>
<td>.30</td>
<td>.23*</td>
<td>2.67</td>
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<td>MTxINT</td>
<td>.67*</td>
<td>.14</td>
<td>1.20</td>
<td>.27</td>
<td>.21*</td>
<td>2.51</td>
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*Note: BMI = body mass index; PBC = perceived behavioural control; MTxINT = interaction between mental toughness and intentions; gender (0 = female, 1 = male).
Figure 1. Visual display of simple slopes of the interaction between mental toughness and intentions for exercise behaviour.
Supplementary Material

Appendix A – Items of the theory of planned behaviour

Items measuring attitude were preceded by the common stem, “For me, doing rehabilitative exercise, on average, for 30 minutes about 3 times a week over the next 2 weeks would be…” Participants’ responses are made on four 7-point semantic differential scales with the following bipolar adjectives: “pleasant-unpleasant”, “enjoyable-unenjoyable”, “beneficial-harmful” and “wise-foolish”. Measures of subjective norms (two items; e.g., “People who are important to me think I should do rehabilitative exercises for my knee, on average, for 30 minutes about 3 times a week over the next 2 weeks”), perceived behavioural control (two items; e.g., “How much control do you feel you have over completing rehabilitative exercises for your knee, on average, for 30 minutes about 3 times a week over the next 2 weeks”) and intention (two items; e.g., “I intend to spend, on average, 30 minutes doing rehabilitative exercises for my knee about 3 times a week over the next 2 weeks) were rated on 7-point Likert-type scales (e.g., 1 = strongly disagree, 7 = strongly agree).
Appendix B – Descriptive statistics and bivariate correlations among study variables for the total sample (n = 136).

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Mean       | .90 | 1.86 | 4.98 | 3.95 | 4.54 | 3.10 | 4.96 | 50.16 | 75.93 | 81.10 |
Standard deviation | 2.19 | 3.61 | 1.18 | 1.45 | 1.39 | 1.61 | 1.02 | 11.59 | 15.54 | 18.07 |
Range      | 0-16 | 0-28 | 1-7  | 1-7  | 1-7  | 1-7  | 1-7  | 10.71-85.71 | 22.22-100 | 25-100 |

Note: internal reliability estimates are presented on the diagonal in parentheses; * p < .05; ** p < .001.