The Relationship Between the Challenge-Skill Balance and Flow: A Meta-Analysis

Abstract

Flow is described as an intrinsically motivating state of consciousness characterized by the simultaneous perception of high challenge and skill. The position that challenge-skill balance is the primary prerequisite for achieving a flow state is unclear and more research is needed to examine its impact on flow within multiple domains. Therefore, a meta-analysis was conducted on 15 studies examining the challenge-skill balance related to flow in a variety of contexts. The results indicated that the relationship between challenge-skill balance and flow was moderate, and this correlation was stronger in non-academic compared to academic contexts. Therefore, there may be a weaker challenge-skill balance in learning environments, which demands greater attention on how to fit together challenging assignments with appropriately skilled students.

Objective

Over 30 years of research has accumulated on the construct of flow across a variety of domains (see Csikszentmihalyi, 1990). Flow theory posits that intrinsic motivation peaks in activities characterized by the simultaneous perception of high challenge and skill. In particular, the skills-demands fit hypothesis of flow theory has been a center of much debate. Csikszentmihalyi (1975) concluded that the subjectively perceived fit between the challenge of an activity and the skills of the individual is the most important prerequisite of experiencing flow (Schiefele & Raabe, 2011). Therefore, a meta-analysis on the relationship between the challenge-skill balance and flow is not only timely, but also essential in empirically assessing the overall impact of this important flow component.

Theoretical Framework

Flow Theory

Flow refers to a psychological state experienced by an individual engaged in an intrinsically motivated activity (Csikszentmihalyi, 1975; Csikszentmihalyi, Abuhamdeh, & Nakamura, 2005; Waterman et al., 2003). Looking for basic features of positive and negative experience, Csikszentmihalyi (1975) defined optimal experience or flow as a positive and intrinsically motivating state of consciousness associated with perception of high challenge and personal skills adequate to meet those challenges (Bakker, 2005; Csikszentmihalyi, Rathunde, & Whalen, 1993; Hodge, Lonsdale, & Jackson, 2009). Flow is considered to be an optimal state associated with positive emotional, motivational and cognitive experiences (Hektner, Schmidt, Csikszentmihalyi, 2007). A large number of studies have identified flow experiences in the lives of people from diverse cultural and economic backgrounds (see Csikszentmihalyi & Csikszentmihalyi, 1988; Massimini & Delle Fave, 2000).

Flow’s dynamic structure of the perceived match between high challenge and adequate personal skill has been categorized into four channels: flow (high challenge and high skill), relaxation (low challenge and high skill), apathy (low challenge and low skill), and anxiety (high challenge and low skill) (Csikszentmihalyi, 1975; Csikszentmihalyi et al., 1993; Deichter, 2011).
Therefore, if an activity is either very easy or very difficult in comparison to one’s skill level, the experience of flow will be less strong. Through these studies, Csikszentmihalyi (1990) identified nine antecedents of the flow experience: (a) challenge-skill balance or engaging in challenges that meet one’s current skill level; (b) action-awareness merging (c) clear goals (d) unambiguous feedback (e) concentration on the task at hand (f) sense of control (g) loss of self-consciousness or self awareness; (h) transformation of time or the distorted sense of time and lastly, the autotelic experience or the experience of the activity is intrinsically rewarding and enjoyable (Kawabata & Mallet, 2011; Payne et al., 2011). These nine dimensions do not necessarily occur simultaneously. For example, certain dimensions may be required in order to enter the flow state (i.e., challenge-skill balance, clear goals, unambiguous feedback), while others are characteristics of being in a flow state (i.e., concentration, merging of action and awareness, sense of control, loss of self-consciousness, transformation of time), or the result of the flow experience (i.e. autotelic experience). These additional antecedents and components support how the skill-challenge balance may not be the sole contributor to the achieving a flow state (Shin, 2006; Wang & Chen, 2012).

An important moderator to examine is whether the challenge-skill balance relationship with flow varies depending on domain or context. Given how flow has been studied in numerous contexts, assessing whether academic contexts versus non-academic contexts is a critical issue for educators and education researchers when examining flow. Boredom or lack of student engagement is a chronic issue in the classroom, and the applicability of flow to education is difficult given the compulsory nature of school and learning activities (Kiili & Lainema, 2008; Marzalek, 2006; Shernoff, Csikszentmihalyi, Schneider, & Shernoff, 2003). This notion will be tested by a moderator analysis, comparing academic versus nonacademic contexts.

Method

The following section describes the procedures used to conduct this meta-analysis, including subsections addressing study inclusion criteria, literature search and information retrieval, coding procedures, effect size calculations, data integration, and search outcomes.

Literature Search Procedures

Studies were collected from a wide variety of sources and included search strategies meant to uncover both published and unpublished research. In order to locate the most exhaustive set of studies, we searched ERIC, PsycINFO, Proquest Dissertation and Theses Full Text, Social Science Citation Index, and Google Scholar electronic databases using a broad array of subject terms including “flow”, while excluding keywords “cash”, “optic”, and “blood” to reduce the number of irrelevant results. We also employed various strategies to directly contact researchers who may have studied underachievement, including listserv posts in various organizations related to gifted education and educational and social psychology. Finally, the reference sections of relevant documents will be examined to determine if any cited works might be relevant to any of our topics.

Criteria for Including Studies

To be included in the meta-analysis, a study was required to meet several criteria. First, studies need to have examined the bivariate relationship between the challenge and skill balance and a measure of flow. Research conducted in academic and nonacademic contexts with participants of any age were included.
Information Retrieved From Studies

Numerous different characteristics of each study will be included in the database. These characteristics encompassed six broad distinctions among studies: (a) the research report; (b) the research design; (c) the flow variable; (d) the sample of students; (e) the measure of the skill-challenge balance (f) the estimate of the relationship.

Two coders extracted information from all reports selected for inclusion. Discrepancies were noted and discussed by the coders, and if agreement was not reached a third coder was consulted.

Methods of Data Integration

Effect Size Calculation. Effect sizes were computed as Fisher’s Z-indices. One problem that arises in calculating average effect sizes involves deciding what constitutes an independent estimate of effect. Weighted procedures were used to calculate average effect sizes across all comparisons in which each independent effect size is first multiplied by the inverse of its variance and then the sum of these products is then divided by the sum of the inverses (see Cooper, Hedges, & Valentine, 2009). Also, 95% confidence intervals will be calculated for average effects to assess significance. When this information is not reported in a study, corresponding inference test statistics (e.g., $p$-values) will be used to derive an effect size. In the case when sample size information is unavailable, we used the inference test with assumed equal sample sizes (see Rosenthal, 1994). If statistical significance is denoted, yet both raw data or inference test statistics were unavailable, a conservative effect size was derived with an assumed $p$-value of 0.05.

One problem that arises in calculating average effect sizes involves deciding what constitutes an independent estimate of effect. Here, we used a shifting-unit-of-analysis approach (Cooper, 1998). This approach involves coding as many effect sizes from each study that exist as a result of variations in characteristics of the intervention, sample, setting, and outcomes within the study. However, when calculating the overall effect size, the multiple effect sizes will be averaged to create a single effect size for each study. To calculate an overall effect size of the intervention, a weighted average of all effect sizes will be computed and entered prior to analysis, so that the study will only contribute one effect to the assessment of the overall effects of the intervention on achievement. The shifting-unit-of-analysis approach maximizes the amount of data from each study without violating the assumption of independent data points. Weighted procedures will be used to calculate average effect sizes across all comparisons in which each independent effect size is first multiplied by the inverse of its variance and then the sum of these products is then divided by the sum of the inverses (Cooper, Hedges, & Valentine, 2009).

Moderator analyses. We conducted moderator analyses when tested using homogeneity analyses (Cooper, Hedges, & Valentine, 2009). Effect sizes may vary even if they estimate the same underlying population value; therefore, homogeneity analyses are needed to determine whether sampling error alone accounted for this variance compared to the observed variance caused by features of the studies. We tested homogeneity of the observed set of effect sizes using a within-class goodness-of-fit statistic ($Q_w$), which follows a chi-square distribution with $k - 1$ degrees of freedom ($k$ equals the number of effect sizes). A significant $Q_w$ statistic suggests that sampling variation alone cannot adequately explain the variability in the effect size estimation; it follows that moderator variables should be examined (Cooper, 1998). Similarly, the $Q_b$ statistic indicates that average effect sizes vary between categories of the moderator variables more than predicted by sampling error alone.
Analyses were conducted using both fixed and random error assumptions (Cooper, Hedges, & Valentine, 2009). In a fixed effects model of error, each effect size’s variance is assumed to reflect only sample error or differences among participants in the study. In a random effects model of error, a study-level variance component also is assumed to be an additional source of random variation. Due to the potential to over- or underestimated error variance in moderator analysis (Hedges & Vevea, 1998), we conducted all the analyses twice using both models of error in order for sensitivity analyses to examine the effect of different assumptions. All statistical analyses were conducted using the Comprehensive Meta-Analysis statistical software package (Borenstein, Hedges, Higgins, & Rothstein, 2005).

Results

The literature search uncovered 12 studies that tested the difference between underachievers and non-underachievers on internal and external attributions, motivation, value, self-regulation, and self-concept. The 12 studies reported 15 effect sizes based on 15 separate samples (N = 4359).

Under a fixed error model, the overall relationship between the skill-challenge balance and flow (a normally distributed and weighted correlation or Fisher’s z) was 0.31 with a 95% CI from 0.28 to 0.33, indicating a small to moderate relationship. Under a random-error model, the weighted average correlation was 0.45 with a 95% CI from 0.33 to 0.57. Additionally, the tests of the distribution of effect sizes revealed that the hypothesis that the effects were estimating the same underlying population could be rejected ($Q$(14) = 340.21, $p < .001$), or that the averaged correlation was greater than zero. Despite challenge-skill balance being the most important prerequisite to flow according to Csikszentmihalyi (1975), the overall relationship was only small to moderate, suggesting the potential importance of other components of flow.

Next, the academic and non-academic moderator of the relationship between underachievement and self-conceptual, motivational, and self-regulatory outcomes were assessed. All the effects of underachievement were found to be statistically heterogeneous; therefore, moderator analyses were conducted to help explain variation among effect sizes.

For only the fixed error model, results indicated that relationship between challenge-skill balance and flow significantly varied by whether the activity was academic or non-academic, $Q$(1) = 19.77, $p < .001$. Under the fixed error model, the weighted average correlation for academic contexts was 0.24 with a 95% CI from 0.19 to 0.33 whereas for non-academic contexts, the correlation was 0.36 with a 95% CI from 0.33 to 0.40. This result indicates that the relationship between challenge-skill balance and flow is stronger for non-academic contexts.

Discussion & Scholarly Significance

The results indicated that the relationship between challenge-skill balance and flow was moderate, and this relationship was stronger in non-academic contexts compared to academic contexts. The other eight theorized antecedents to flow need additional scholarship in order to assess the relative strength of challenge-skill balance on flow, and potentially challenging the basis of flow theory. In addition, given that this relationship is stronger in non-academic contexts, there may be a weaker balance between challenge and skill in learning environments, which demands greater attention on how to fit together challenging assignments with appropriately skilled students.

Methodologically, the majority of the studies (all but one) used a survey to assess flow and the challenge-skill balance. Flow research has moved towards experience sampling
methodology (ESM) to assess momentary variation in subjectively reported experiences in order to examine flow, a more accurate assessment of this state. Interestingly, the only study that used ESM reported the weakest correlation ($r = 0.04$), which also points to a weak relationship between flow and the challenge-skill balance (Chen, 2000).
Table 1
Results of Analyses Examining the Relationship Between Flow and the Challenge-Skill Balance.

<table>
<thead>
<tr>
<th>Challenge-Skill Balance</th>
<th>k</th>
<th>d</th>
<th>95% confidence interval</th>
<th>Q</th>
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<td></td>
<td></td>
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<td>High Estimate</td>
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<td>0.28</td>
<td>0.33</td>
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<td>Random Model</td>
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***p < .001
### Table 2
Results of Moderator Analyses Examining the Differences by Domain

<table>
<thead>
<tr>
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<th>$k$</th>
<th>$d$</th>
<th>95% confidence interval</th>
<th>$Q_b$</th>
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<td>High Estimate</td>
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<td>Random Model</td>
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<tr>
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<tr>
<td>Random Model</td>
<td></td>
<td>0.45***</td>
<td>0.31</td>
<td>0.65</td>
</tr>
</tbody>
</table>

Note. Fixed-effects values are presented outside of parentheses and random-effects values are within parentheses. 

***$p < .001$
References


