



## Manipulating autonomy, competence, and relatedness support in a game-learning context: New evidence that all three needs matter

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Self-report correlational data support self-determination theory's (SDT's) postulate that there are three basic psychological needs, for autonomy, competence, and relatedness, which combine additively to predict well-being and thriving. However, experimental research in the SDT tradition has focused only on autonomy support, not relatedness and competence support. To fill this gap, we employed a  $2 \times 2 \times 2$  factorial design within a game-learning experience to predict rated need satisfaction, mood, and motivation, and also objective game performance. Manipulated competence and relatedness support had main effects on most outcomes. Rated competence, relatedness, and autonomy need satisfaction also predicted the outcomes, and the significant experimental main effects were all mediated by the corresponding rated variables. Neutral control group data showed that thwarting participants' needs is more impactful than enhancing them. These findings offer new support for key postulates of SDT, while integrating the correlational and experimental traditions in this area.

A central tenet of self-determination theory (SDT; Deci & Ryan, 1985, 1991, 2000) is that human beings have three basic psychological needs, namely, for autonomy, competence, and relatedness. These needs are defined as required 'inputs' that contribute additively to human thriving, in the same way that plants require certain vital inputs in order to thrive (Ryan, 1995). Autonomy involves feeling internal assent regarding one's behaviour, rather than feeling controlled or pressured; competence involves feeling efficient, effective, and even masterful in one's behaviour, rather than incompetent and ineffective; and relatedness involves feeling meaningfully connected to others, rather than feeling alienated or ostracized. Furthermore, the needs are defined as evolved and species typical, and are thus thought to be universally relevant within all people and all cultures (Deci & Ryan, 2000). The SDT conception of needs contrasts

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with the motive disposition conception, which focuses upon needs as acquired individual differences in behavioural orientations (McAdams, 2001; McClelland, 1985) that have no necessary relations with thriving and Maslow's conception, which assumes a hierarchically contingent rather than an additive relation among universal needs (Maslow, 1971).

The purpose of the present study was to test key tenets of SDT in a way they have not been tested before, via an experimental manipulation of all three needs in a 2 (autonomy support: yes or no) × 2 (competence support: yes or no) × 2 (relatedness support: yes or no) between participants factorial design. Participants were taught to play the game 'Boggle' in one of the eight ways, and both their experience of the lesson, and their objective performance on a Boggle skills test, were examined as dependent variables. Below we consider the theoretical issues and gaps in the empirical literature that this design allowed us to address.

SDT began with, and is still based upon, the 'undermining' effect (Deci, 1972). This was the finding that people are less inclined to play with an intrinsically interesting game or puzzle after they have been paid for completing, or even simply engaging in, the puzzles. Later research showed that intrinsic motivation could also be undermined by threats, surveillance, deadlines, and competition (Deci & Ryan, 1985; see also Deci, Koestner, and Ryan's 1999 meta-analysis). Deci and colleagues argued that all of these conditions tend to thwart a basic human need for autonomy (Deci & Ryan, 1991). In other words, when people perceive proffered rewards or imposed demands as attempts to coerce or control them, then they tend to lose interest in the task. Notably, SDT offers an account of optimal experience that complements Csikszentmihalyi and colleagues' research on 'flow', a construct that is conceptually similar to intrinsic motivation (Csikszentmihalyi, 1997). Whereas flow is maximized when skills match task demands, thereby producing a strong sense of *competence* within the task setting, Deci and colleagues showed that intrinsic motivation is also affected by feelings of *autonomy* within the task setting.

Over the past three decades, SDT researchers have continued to manipulate autonomy support (vs. control) within experimental settings (Deci, Eghrari, Patrick & Leone, 1994; Reeve, Jang, Carrell, Jeon, & Barch, 2004) and within intervention studies (Williams, Grow, Freedman, & Deci, 1996; Williams *et al.*, 2006), showing consistent effects of this social-contextual variable. However, the experimental research has in some ways lagged behind the more general development of SDT. Again, within the last 15 years, SDT has assimilated competence and relatedness needs, in addition to autonomy needs, within its theoretical account. However, competence and relatedness needs have rarely been manipulated as experimental factors by SDT researchers. Of course, success versus failure feedback (presumably affecting competence needs) and acceptance versus exclusion feedback (presumably affecting relatedness needs) have been studied within other theoretical traditions (Higgins & Spiegel, 2004; Shah, 2003; Twenge & Baumeister, 2005); however, the three proposed SDT needs have never been simultaneously manipulated within a single published study.

Instead, SDT research has typically proceeded by measuring satisfaction of the three needs via self-report, both as an individual difference and as an indicator of the 'quality' of particular contexts or moments in time. It is now well established that rated autonomy, competence, and relatedness are each important for predicting both momentary and longer term positive mood, well-being, and thriving. For example, Sheldon, Ryan, and Reis (1996) and Reis, Sheldon, Gable, Roscoe, & Ryan (2000) showed that daily fluctuations in these three needs combine to predict daily fluctuations

in well-being; Filak and Sheldon (2003, in press) showed that all three needs within the college classroom combine to predict positive teacher-course evaluations; La Guardia, Ryan, Couchman, and Deci (2000) showed that all three needs combine to predict secure attachment relationships; and Sheldon, Elliot, Kim, and Kasser (2001) showed that all three needs are distinct components of 'satisfying events'. The latter research also showed that the same pattern occurs in South Korea, typically assumed to be a collectivist culture in which autonomy might matter less (Markus, Kitayama, & Heiman, 1996). Consistent with the universalist assumptions of SDT, autonomy was equally important in South Korea (see also Hahn & Oishi, 2006; Sheldon *et al.*, 2004).

Although these findings provide good preliminary support for the simultaneous importance of all three needs, the fact that the findings are all based on self-report is a weakness. Might the associations of need satisfaction with well-being be resultant from self-report artefacts or shared method variance? Also, might need satisfaction be a *result* of well-being, rather than a *cause* of it (Lyubomirsky, King, & Diener, 2005; Ryff & Keyes, 1995), as is typically assumed by SDT? The problem is that, to date, there is no experimental evidence that all three needs are uniquely important. This is a significant omission, because SDT is ultimately a socio-dialectical theory that focuses on how thwarting versus supportive social contexts affect individual functioning. To better support SDT, it is important to experimentally manipulate the three needs within the social context, to examine whether each experimental factor has unique causal effects, as expected.

In the current research, we set out to perform just such an experiment. The study promised to yield several benefits. First, we hoped to validate the SDT proposal that all three needs have unique main effects upon thriving, using a more rigorous experimental methodology. Our primary study hypothesis was that each need supportive factor would have effects upon at least some of the outcomes examined. Second, we hoped to explore the possibility of two-way or even three-way interactions between the needs. For example, might relatedness be especially beneficial if it comes with (rather than without) autonomy and vice versa? Because SDT predicts only additive relations between need satisfaction and outcomes, and because interactions have not been found in previous self-report need satisfaction data, we expected to find no interactions in the current experiment. A third benefit of the study was that it enabled us to examine the exact pattern of effects of the three needs upon a range of outcomes. SDT typically does not make outcome-specific predictions, instead expecting generally positive effects of need satisfaction upon all positive outcomes. However, we hoped to supply more specific information by discovering which (if any) types of outcome (i.e. mood, performance, satisfaction, motivation) are most affected by competence, and which outcomes are affected most by relatedness, and so on. Such findings might give researchers and social engineers new insight into the possible trade offs that occur when they create social contexts that prioritize satisfaction of one need at the expense of another.

We chose to use a game-learning context, conceptually similar to ones that were used in the early intrinsic motivation research. Specifically, participants were taught to play the game of 'Boggle', a timed task in which one tries to form as many words as possible from a 4 × 4 letter grid. This popular game was chosen because it is interesting and enjoyable for most people, allowing us to examine the intrinsic motivation undermining issue. The game requires considerable effort and cognitive flexibility, as successful players must rapidly consider many possible letter combinations and letter sequences in the search for valid words. Participants were randomly assigned to one of

the eight conditions (described below), which varied the utterances of the experimenter during introductory, learning, and performance phases of the sequence. These manipulations were designed to either detract from, or enhance, need satisfaction. In addition, we employed a neutral control group as a ninth condition, so that we could evaluate which is more important – detractions from, or enhancements to, baseline need satisfaction.

As dependent measures we examined rated satisfaction of autonomy, competence, and relatedness needs. These ratings served as both manipulation checks and as possible psychological mediators of the condition effects. In addition, we examined positive and negative mood during the experience, as mood has been a typical outcome of prior rated need satisfaction research (Sheldon *et al.*, 1996; Sheldon *et al.*, 2001). Furthermore, we also assessed self-reported intrinsic motivation (interest and enjoyment) and participants' willingness to recommend the experiment to other people. Finally, we examined participants' objective game scores during the performance phase, controlling for scholastic aptitude. We hoped to show that psychological need satisfaction also affects actual performance in this verbal dexterity task.

## Method

### **Participants and procedure**

Participants were 196 introductory psychology students at the University of Missouri, 81 men and 114 women (one participant did not report gender), who participated to help satisfy a course requirement. Participants were run one at a time by one of the three experimenters, through a procedure in which a Demographics Questionnaire was completed. Then the experiment and game were introduced, and then a pre-test grid was given. The participant then received feedback and three hints before being given a second test grid followed by a final questionnaire. Three different grids were used for the pre-test and also for the test (six grids in all), and were equivalent in difficulty according to the book from which they were taken (Lamford & Canfield, 1999). Participants were either assigned a grid or given a choice between grids, the latter as part of the autonomy support conditions. Once presented with a grid, participants had 3 minutes to write down as many words as they could. Participants' scores on the pre-test and final test grids were later calculated for analysis, by considering both the number and length of the valid words listed. Participants were also asked for their ACT (scholastic aptitude) scores on the Demographics Questionnaire, for use as a control variable.

### **Need support manipulations**

The three experimental factors differed primarily in the substitution of certain sentences or phrases for other sentences or phrases, within the experimenter script. Autonomy, competence, and relatedness were manipulated separately, so that scripts could be assembled to represent all possible combinations of the  $2 \times 2 \times 2$  (i.e. relatedness but not competence or autonomy support, or, competence and relatedness support but not autonomy support). The autonomy support (vs. controlling) manipulation was based on typical procedures of past SDT research (Deci *et al.*, 1994; Reeve, Hyungshim, Carrell, Jeon, & Barch, 2004; Sheldon, Williams, & Joiner, 2003). The competence and relatedness support manipulations were based on the

conceptual definitions of these needs provided by Deci and Ryan (2000). Participants were randomly assigned to one of the eight conditions; cell *N*s ranged from 18 to 22.

In addition, a ninth cell was run, in which neither the enhancing nor detracting phrases were included ( $N = 39$ ). Although ideally there would have been a separate mid-level condition for all three of the need support factors, this would have resulted in 27 experimental conditions, an unfeasible design. However, we reasoned that a hanging control group design might still be important for establishing a baseline for the case in which none of the needs are detracted from, nor enhanced, in any intentional way.

#### *Autonomy support*

For all participants, the instructions began: 'OK, its time to begin. First, here is some general information'. Following this, participants received either one, two, or three extra introductory statements, depending on their condition assignments. In the autonomy support conditions, participants heard: 'In this experiment, we just want you to play around with the puzzles, learning to do them your own way. You can choose which puzzles to do, and also, you can choose which hints you want to try first. Just try to get into it, and see where it goes'. Thus, the autonomy support manipulations emphasized choice, self-direction, and the participant's perspective upon the task. Participants in the non-autonomy conditions instead heard: 'In this experiment you must do exactly as I say, learning to do the puzzles our way. In order to achieve experimental control, we can't let you have any choice about which puzzles to do, nor about which order you do the hints in. We know what we're doing, so just follow my instructions exactly, please'. Thus, experimenter control and the absence of choice were emphasized. Again, in the hanging control group, neither type of phrase was included. This continues to be the case throughout the subsequent manipulation descriptions, and thus we will not discuss the control group instructions further.

When the pre-test was introduced, participants in the autonomy conditions were allowed to pick between a pink, green, and yellow grid (without seeing the actual letters in them); participants in the non-autonomy conditions were simply told 'we can't offer you a choice about which grid to do'. When the hints were given, autonomy participants were allowed to choose the order in which the three hints were presented, and non-autonomy participants were told they could not have a choice (the three hints involved looking for consonant combinations, looking for vowel combinations, and proceeding systematically through the grid). When the final test grid was given, autonomy participants were allowed to choose the pink, green, or yellow grid, and non-autonomy participants were not. Participants in the non-autonomy conditions were yoked to the most recent participant in the autonomy condition, receiving whatever grids (pre-test and post-test) that last participant had chosen.

#### *Relatedness support*

In the relatedness-support conditions, following the general information statement and possibly the first autonomy-relevant statement, participants heard: 'One thing you need to know is that to us, everybody is unique. We care about each person as an individual, and are trying to understand each person's learning style. So, I hope you'll share your experiences with me after we're done'. Thus, acknowledgement, caring, and interest in

the participants' experiences were emphasized. In the non-relatedness conditions, participants were told: 'Another thing you need to know is that to us, everybody is the same. We aren't really concerned about you as an individual, we only care about your performance in our experiment, that is, the data. So, please keep your observations to yourself during the process'. Thus, disinterest in the participant as a person was conveyed.

In the relatedness conditions, prior to the pre-test, the experimenter said: 'Just to remind you: remember, we care about you and your individual learning style. So, please be sure to remember what you were thinking and feelings, so we can discuss your reactions later'. In the non-relatedness conditions, participants were told: 'Just to remind you: remember, we're not really interested in your reactions and individual learning style. So, please keep your questions and observations to yourself, as we go through the procedure'. When the hints were given, relatedness participants were told: 'The first time I did these puzzles I found the hints really helpful, and I bet you will too;' non-relatedness participants did not hear this. Prior to the final test, relatedness participants were told: 'OK, its time for the final timed test. I can sympathize with what you might be feeling now: you're not sure you like tests like this. Just remember that we know you are a unique individual, with your own learning styles. We're focused on trying to understand you personally, not just the game itself'. Non-relatedness participants heard 'OK, its time for the final timed test. You may be thinking that you don't like tests, but that doesn't matter. Remember, to us you're just one anonymous participant, the same as everybody else. We're focused on trying to understand the game, not you personally'.

#### *Competence support*

In the competence support conditions, following the general information statement and also possibly the introductory autonomy- and relatedness-relevant statements, participants heard: 'One thing to keep in mind is that this puzzle is quite challenging. The puzzle involves finding as many words as possible, and beginners find that they only scratch the surface of the possible words. Just do the best you can, and you'll improve quickly. I have confidence in you!' Thus, positive expectancies and a learning orientation were encouraged. Participants in non-competence conditions were told: 'One thing to keep in mind is that this puzzle is quite difficult. The puzzle involves finding as many words as possible, and beginners (like you) usually don't find very many words. Still, do the best you can, even if seems hard. Maybe you'll be lucky!' Thus, low expectancies and the role of chance were emphasized.

Similarly, prior to the pre-test, competence participants were told: 'OK, like I said before, this first challenge is to give us a sense of how well you can do at the beginning. In fact, students at MU do quite well at this, initially. I'll give you 3 minutes to find as many words as you can in this grid. Write each one down, as you see it, as many as you can in the 3 minutes. Just relax and get into it, I'm sure you'll do well'. Non-competence participants were told: 'OK, like I said before, this first exam is to give us a sense of how poorly you do at the beginning. In fact, students at MU do quite badly at this, initially. I'll give you 3 minutes to find as many words as you can in this grid. Write each one down, as you see it, as many as you can in the 3 minutes. Just try as hard as you can, and hopefully you won't do too badly'. After the pre-test, all participants were told: 'It looks like you found about X words, out of the 70 or so that are in there' (X was the number of words participants wrote down during the trial). Competence participants

were told: 'Very good, that's an excellent beginning! And I'm sure you can do even better next time'. Non-competence participants were told: 'Well, that's a start. Hopefully you can do a little better next time'. Before the hints were given, competence participants were told: 'I'm sure you'll get these right away, and that they'll help you improve your performance'. Non-competence participants were told: 'You may have some trouble with these hints, but maybe they will help you improve your performance'. As participants applied the hints, competence participants were asked to 'show me how well you understand this hint' and after the hint was presented, were told: 'You got that fast!' Non-competence participants were asked to 'show me what you don't understand about this hint' and were afterwards told: 'OK, though you're a little slow'. Prior to the final test, competence participants were told: 'It seems like you've gotten the hints, and I'm sure you'll do well!' Non-competence participants were told: 'It seems like you're struggling a little with the hints, but maybe you'll do OK'.

### **Measures**

#### *Rated need satisfaction*

Nine items were used to assess the three needs, which were based on scales used by Sheldon *et al.* (2001). For autonomy, the items were: 'I felt that I had a choice about how to apply the hints and play the game', 'I felt like I had a choice about which grids to do', and 'I felt that my teacher provided me with choices and options'. For competence, they were: 'I felt that I picked up on the hints very well', 'I did well at the game', and 'I feel that I probably got more words than most people would get'. For relatedness, they were: 'I felt that my teacher accepted me', 'I don't feel very good about the way my teacher talked to me' (R), and 'I don't feel the teacher liked or understood me'. (R) All items were administered with a 1 (strongly disagree) to 5 (strongly agree) scale.

A principal components analysis of the nine items revealed three components with eigenvalues greater than 1.0, which accounted for 35%, 20%, and 15% of the variance, respectively. Because the components were correlated, we used an oblimin rotation and found that the components were defined by either the three autonomy items, the three competence items, or the three relatedness items (all loadings greater or equal to .59; no cross-loadings greater than .39). Thus, we created a summary satisfaction score for each need (coefficient  $\alpha = .70, .80, \text{ and } .81$ , respectively).

#### *Mood*

After the post-test participants were asked 'to what extent do you feel this way right now?' with regard to the 20 adjectives of the Positive affect/Negative affect Scale (PANAS; Watson, Tellegen, & Clark, 1988). Positive affect and negative affect scores were created from these ratings ( $\alpha = .89 \text{ and } .86$ , respectively).

#### *Self-report intrinsic motivation*

Two items were employed, based on the Interest/Enjoyment Scale of the intrinsic motivation inventory (Deci *et al.*, 1994; McAuley, Duncan, & Tammen, 1987). The items were 'I enjoyed the challenges this lesson provided' and 'I would be interested in playing this game again', and they were averaged to create an 'intrinsic motivation' variable ( $\alpha = .78$ ).

*Willingness to recommend the game to others*

Three items were employed: 'I would recommend this psychology experiment to a friend', 'I would recommend this Boggle teacher to a friend', and 'I would recommend the Boggle game to a friend'. They were averaged to form a 'willingness to recommend' variable ( $\alpha = .75$ ).

*Objective performance*

Each participant received a word score for both the pre-test and the final test, based on counts of the number of valid words listed. In addition, each participant received a point score for both the pre-test and final test, where three-letter words counted one point, four-letter words counted two points, and five-letter words counted four points as per the standard rules of Boggle. The word and point variables were highly correlated ( $r_s = .98$  and  $.95$  for the pre-test and final test, respectively), so we standardized and combined them separately for the two tests. The aggregated pre-test and post-test performance variables were correlated  $r = .65$ , showing both substantial test-retest reliability and some room for variation from before to after the lesson. We intended to control for pre-test performance in the final performance analyses, so that positive improvement over the session would be the focus of the analyses.

**Results*****Preliminary analyses***

Table 1 contains means and standard deviations for all of the self-report variables, as well as the correlations among these variables. None of the means varied by gender.

**Table 1.** Means, standard deviations, and correlations for the self-report variables

	Mean	SD	1	2	3	4	5	6	7	8
1. ACT score	25.75	3.55								
2. Prior exp.	1.86	0.93	.17							
3. Autonomy sat.	3.36	1.06	-.15	.10						
4. Competence sat.	2.92	0.85	.00	.23	.22					
5. Relatedness sat.	4.04	0.88	-.21	.00	.33	.25				
6. Intrinsic mot.	3.82	0.97	-.02	.15	.31	.35	.47			
7. Positive affect	2.82	0.74	-.21	.22	.16	.49	.31	.48		
8. Negative affect	1.65	0.62	.04	-.10	-.16	-.33	-.32	-.20	-.18	
9. Recommend	3.79	0.82	-.24	.13	.35	.36	.62	.72	.47	-.30

Note. For correlations  $\geq .18$ ,  $p \leq .01$ . For correlations  $\geq .14$ ,  $p \leq .05$ .

As a manipulation check, we conducted a 2 (autonomy support: yes or no)  $\times$  2 (competence support: yes or no)  $\times$  2 (relatedness support: yes or no) between-subjects MANOVA upon the three rated need satisfaction scores. In this analysis, the relatedness support factor had a significant main effect upon the relatedness need satisfaction score ( $F(1, 149) = 7.09$ ,  $p < .01$ ), and had no significant effect upon the autonomy or competence need satisfaction scores. The autonomy support factor had a significant main effect upon the autonomy need satisfaction score ( $F(1, 149) = 183.8$ ,  $p < .01$ ), and had no significant effect upon the relatedness or competence need satisfaction



scores. The competence support factor had a significant main effect upon the competence need satisfaction score ( $F(1, 149) = 8.0, p < .01$ ), and had no effect upon the autonomy need satisfaction score. However, the competence support factor also had a significant main effect upon relatedness satisfaction ( $F(1, 149) = 19.5, p < .01$ ), indicating that this factor influenced feelings of both competence and relatedness.<sup>1</sup> This may be unsurprising, given that the competence manipulation included utterances such as 'I have confidence in you!' Overall, this analysis showed that each manipulation affected the expected satisfaction score, with one of the manipulations also affecting a second satisfaction score. There were no significant two-way or three-way interactions among the three factors with respect to the three rated satisfaction scores.

To incorporate the neutral control condition and isolate the source of the effects, we conducted three MANOVAs upon the three rated need satisfaction variables, one for each need factor, in which the neutral control condition was coded '0' and the depriving and enhancing conditions were coded '-1' and '1', respectively.<sup>2</sup> In these three analyses the same pattern of main effects emerged as above, i.e. each factor affected its own manipulation check variable but not the others, again with the exception that competence support affected both felt competence and felt relatedness.

However, inspection of the means suggested that the source of these factor-specific effects lay largely in the comparison between the deprivation group and the neutral control group. Three analyses contrasting the appropriate manipulation check variable across the deprivation and control groups confirmed this (degrees of freedom for these tests ranged from 115 to 118; all three *t*s significant at  $p < .05$ ). In comparison, none of the three contrasts between the enhancement group and the neutral control group were significant (all three *t*s non-significant at  $p > .05$ ), except that rated autonomy in the neutral control group was significantly lower than rated autonomy within the autonomy-enhanced group. Thus, it appears that within this type of game-playing context, it may be more important to avoid thwarting participants' needs rather than to make a particular attempt to meet them.

### **Primary analyses**

#### *Mean differences on self-report outcomes by manipulated condition*

Table 2 contains means for the primary outcome variables, split by condition (the neutral control condition data are omitted from the table for clarity sake and will be discussed below). To compare effects upon the four self-report outcomes (intrinsic motivation, positive affect, negative affect, and willingness to recommend the experiment), we conducted the same  $2 \times 2 \times 2$  between-subjects analysis described above. Again, we predicted that each factor would have main effects upon at least some of the outcomes and did not expect interactions.

Relatedness support had a significant effect ( $F(1, 149) = 5.20, p < .01$ ) and competence support a marginally significant effect ( $F(1, 149) = 3.17, p = .07$ ) upon intrinsic motivation, such that intrinsic motivation was higher in the relatedness and competence support conditions; autonomy support did not have a main effect. There

<sup>1</sup> There were no significant three-way interactions, but one of the nine two-way interactions was significant ( $F(1, 142) = 6.5, p < .05$ ), such that the combination of low autonomy support and low competence support produced much lower relatedness need satisfaction. We will not interpret this interaction, since it did not involve the corresponding condition (relatedness support to relatedness satisfaction) and may represent a chance finding.

<sup>2</sup> Because of the stand-alone control condition, it was not possible to do these tests in just one analysis as above.

**Table 2.** Means on the self-report variables split by experimental condition

		Autonomy			
		Non-Supportive		Supportive	
		Competence		Competence	
		NS	S	NS	S
Relatedness Non-supportive	Intrinsic mot.	3.05	3.84	3.58	3.84
	Positive affect	2.54	2.96	2.66	2.76
	Negative affect	1.98	1.75	1.90	1.56
Relatedness Supportive	Recommend	3.10	3.84	3.53	3.83
	Intrinsic mot.	3.87	3.98	3.97	3.94
	Positive affect	2.77	3.12	2.75	2.76
	Negative affect	1.59	1.41	1.47	1.53
	Recommend	3.67	4.33	3.97	3.80

Note. NS = Non-supportive, S = Supportive.

were no significant interactions. Competence support had a marginally significant main effect upon positive affect ( $F(1, 149) = 3.54, p = .06$ ); no other effects were significant. Regarding negative affect, relatedness support had a significant effect ( $F(1, 149) = 9.28, p < .01$ ) and competence support a marginally significant effect ( $F(1, 149) = 3.18, p < .08$ ), such that negative affect was higher in the non-supportive conditions. Autonomy support was non-significant, and there were no interactions. Regarding participants' willingness to recommend the study, there were significant positive effects of both competence support ( $F(1, 149) = 9.07, p < .01$ ) and relatedness support ( $F(1, 149) = 8.07, p < .01$ ), and no main effect of autonomy support. However, there was a significant autonomy support  $\times$  competence support interaction upon willingness to recommend ( $F(1, 149) = 6.24, p < .05$ ); when autonomy support was absent, competence support had a large effect ( $M_s = 4.09$  for competence support present vs.  $3.38$  for competence support absent,  $t(76) = 3.86, p < .01$ ), and there was no effect of competence support when autonomy support was present ( $M_s = 3.82$  vs.  $3.74, t(77) = 0.40, ns$ ). In sum, manipulated competence and relatedness each evidenced several significant main effects, whereas manipulated autonomy evidenced only one interaction effect. The relative weakness of the autonomy support manipulation will be discussed later in the article.

Next, we considered the means on the self-reported outcome variables for the neutral control condition. The means for intrinsic motivation, positive affect, negative affect, and willingness to recommend were  $4.09, 2.93, 1.67,$  and  $3.94,$  respectively. Comparison of these means with the means in Table 2 suggested that once again, the source of the omnibus main effects lay primarily in the difference between the depriving condition and the control condition, rather than in the difference between the enhancing condition and the control condition. Contrast analyses again supported this supposition, as none of the 12  $t$  test contrasts of the neutral versus enhancement conditions were significant, whereas 6 of the 12 contrasts of the neutral versus deprivation conditions were significant (these six corresponded to the omnibus main effects reported above).

Finally, as a way of clarifying the manipulated condition effects upon the self-rated outcomes, we created a variable indexing the number of supportive versus detracting conditions assigned to the participant (Deci *et al.*, 1994), where 1 = three negative, no positive; 2 = two negative, one positive; 3 = neutral control; 4 = two positive, one negative; and 5 = three positive. We then correlated this variable with intrinsic motivation, positive affect, negative affect, and willingness to recommend. Three of the four correlations were significant ( $r_s = .20, .08, -.24$ , and  $.26$ , respectively). Essentially, the same pattern emerged when the neutral control group was excluded and 5 was recoded to 4 and 4 was recoded to 3 ( $r_s = .23, .09, -.25$ , and  $.28$ ). These results are consistent with SDT's presumption that all three needs are additively important, with the exception of the non-significant effect upon positive affect.

#### *Effects on game performance*

We next turned to the game performance variables. Preliminary correlational analyses showed that ACT score had significant relations with both the pre-test and final scores ( $r_s = .31$  and  $.20$ ,  $p_s < .01$  and  $< .05$ , respectively). Thus, we controlled for ACT, to equate participants on academic ability and to examine the predictive efficacy of need support above and beyond academic ability. Specifically, we tested a model in which the final score was regressed upon three dummy variables representing autonomy support, competence support, and relatedness support (excluding the neutral control participants). The pre-test score and ACT score were also entered into the equation. In this analysis, pre-test score was significant ( $\beta = 0.63$ ,  $p < .01$ ). The relatedness support condition was also significant ( $\beta = 0.12$ ,  $p = .05$ ), whereas competence support and autonomy support were not significant. ACT score was non-significant, indicating that mere academic aptitude did not help participants to gain more in the second trial. Subsequent steps in the analysis established that there were no interactions (two-way or three-way) among the three support factors. In sum, relatedness support apparently helped participants to improve their performance, whereas academic aptitude did not.

To bring the neutral control condition into the performance picture, we regressed post-test score upon pre-test score, ACT score, and two dummy variables representing the relatedness-detracting and the relatedness-enhancing conditions (thus making the neutral control group the reference group). In this analysis, neither dummy variable was significant; however, the relatedness enhancement ( $\beta = 0.12$ ,  $p = .13$ ) condition appeared to be the more important source of the overall relatedness effect than the relatedness deprivation condition ( $\beta = 0.01$ ,  $p = .95$ ).

#### *Associations of rated need satisfaction scores with outcomes*

Next, we examined the associations of the three rated need satisfaction scores with the outcomes, focusing on the full sample. These analyses allowed us to conceptually replicate typical SDT need satisfaction studies, which have in the past relied upon ratings rather than manipulations of the three needs (Deci & Ryan, 2000; Sheldon *et al.*, 1996, 2001). Specifically, we conducted five regressions, one for intrinsic motivation, one for positive affect, one for negative affect, one for willingness to recommend, and one for final game score, in which the three centred need satisfaction scores were entered at the first step, and three interaction product terms (autonomy  $\times$  competence, autonomy  $\times$  relatedness, and competence  $\times$  relatedness) were entered at the second step, and a term representing the three-way interaction (autonomy  $\times$  competence  $\times$  relatedness) was entered at the third step. This procedure

of entering all three satisfaction scores simultaneously at step 1 mirrors that of past research (Sheldon *et al.*, 1996, 2001), and allows the unique contributions of each need to be evaluated. Again, we expected that the three satisfaction scores would tend to have simultaneous main effects upon the outcomes, and did not expect interactions. Table 3 contains the results of these analyses at the first step.

**Table 3.** Simultaneous regression coefficients for the three rated need-satisfaction scores predicting the outcomes

	Autonomy satisfaction	Competence satisfaction	Relatedness satisfaction
Intrinsic motivation	.15*	.23**	.36**
Positive affect	-.01	.44**	.20**
Negative affect	-.01	-.27**	-.26**
Recommend	.13*	.20*	.53**
Final performance	-.03	.32**	.08

Note. In the final performance analysis, pre-performance and ACT score were controlled.

Note. \* $p < .05$ ; \*\* $p < .01$ .

As can be seen in the table, rated competence satisfaction had significant beneficial effects upon all five of the outcomes, consistent with hypotheses and prior research. Rated relatedness satisfaction had significant beneficial effects upon four of the outcomes (excluding performance). Autonomy satisfaction had significant positive effects upon two of the outcomes: intrinsic motivation and the willingness to recommend the experience. None of the two-way or three-way interactions were significant at the later steps.

#### Mediational analyses

We next endeavoured to test whether any of the observed condition main effects could be accounted for by the corresponding rated satisfaction effects, excluding the neutral control group participants. For example, is the competence support factor's effect upon intrinsic motivation mediated by participants' felt competence during the experience? Specifically, we performed seven mediational analyses, one for each of the seven need support effects that were described above in which the corresponding rated variable also had an effect (we did not attempt to mediate the relatedness support to performance effect, because rated relatedness itself was not a significant predictor of performance). In each analysis, we followed the procedures of Baron and Kenney (1986) and employed the Sobel test (Sobel, 1982) to determine whether the associated satisfaction score mediates the effects of each experimental factor. Significant mediation was indicated in all seven cases (all  $z$ s  $> 2.14$ , all  $p$ s  $< .05$ ). Specifically, rated competence satisfaction significantly mediated the effects of the competence support manipulation upon intrinsic motivation, positive affect, negative affect, and willingness to recommend the experience, and rated relatedness-satisfaction mediated the effects of the relatedness support manipulation upon intrinsic motivation, negative affect, and willingness to recommend the experience.

#### Discussion

This study was the first to experimentally manipulate autonomy support, competence support, and relatedness support within the same design. This design afforded a

new and more powerful test of SDT's proposal that all three experiences are basic psychological needs whose satisfaction produces a wide variety of positive outcomes (Deci & Ryan, 2000). Based on SDT, we predicted that all three manipulated factors would have main effects on at least some outcomes, and also expected that rated feelings of autonomy, competence, and relatedness would mediate the condition main effects that emerged. In further accordance with SDT, we did not expect to find interactions between the factors.

The study found that competence support and relatedness support each had unique main effects upon most of the outcomes. These effects applied to a range of outcomes, including rated intrinsic motivation, positive and negative mood, willingness to recommend the game to others, and objective game performance. Furthermore, these effects were largely carried by the corresponding feelings that the manipulations produced within participants, suggesting that the manipulations were successful, focused, and effective.

The pattern for the manipulated autonomy support factor was somewhat different: it merely moderated one of the competence support effects, such that when both competence and autonomy were threatened, participants were especially unwilling to recommend the game to others. One explanation for the lack of autonomy main effects is that the way in which autonomy was manipulated may have seemed somewhat unimportant, for example, supported participants got to pick which colour of grid they wanted to do, and which order they wanted the hints in. Also, the autonomy-detracting manipulation emphasized that participants 'could be given no choice because this is required for experimental control', but rather than creating a feeling of being coerced or controlled, this statement may have seemed normal or even preferable to participants within a scientific study. Finally, the current autonomy manipulation did not address all three positive factors incorporated by Deci *et al.* in their (1994) experiment; although supported participants were offered choice, they were not provided with a meaningful rationale and potential internal conflicts were not acknowledged. Future research, using more multifaceted autonomy supportive versus controlling manipulations and/or more significant choices, will be necessary to better evaluate the effects of this social-contextual factor within this particular game-learning setting. However, given the long research tradition concerning the importance of contextual autonomy support (Deci & Ryan, 2000), we believe it is inappropriate to conclude from the current results that contextual autonomy support is insignificant.

The *rated* autonomy need satisfaction measure performed better, manifesting main effects upon both rated intrinsic motivation and willingness to recommend the experiment. Thus, the subjective feeling of choice had effects that went beyond the mere objective provision of choice, and that also went beyond the effects of rated relatedness and competence satisfaction. The fact that all three of the rated needs had main effects upon at least some outcomes conceptually replicates earlier studies focusing on what makes for a good day (Reis, Sheldon, Gable, Roscoe, & Ryan, 2000; Sheldon *et al.*, 1996), what makes for a secure attachment relationship (La Guardia *et al.*, 2000), what makes for a satisfying event (Sheldon *et al.*, 2001), what makes for a good college course evaluation (Filak & Sheldon, 2003), and so on. Here, it appears that felt autonomy, competence, and relatedness all help make for a 'good Boggle-playing experience', providing new confirmation for an important postulate of SDT.

It is worthwhile to consider the competence support and relatedness support results in more specific detail. The competence effects are consistent with many past studies in educational and social psychology, showing that reduced feelings of effectiveness and

self-efficacy can produce reduced intrinsic motivation (Csikszentmihalyi, 1997), more avoidant goal orientations (Rawsthorne & Elliot, 1999), and lowered persistence and affective tone (Harackiewicz & Sansone, 2000). The relatedness effects are consistent with those of Baumeister, Twenge and their colleagues concerning ostracism and social exclusion (Twenge & Baumeister, 2005), if our non-relatedness manipulation ('we are not interested in you as a person') is construed as at least somewhat excluding. For example, Baumeister, DeWall, Ciarocco, and Twenge (2005) found that social exclusion impaired several types of self-regulation, and Twenge, Catanese, and Baumeister (2003) found that social exclusion increased self-defeating behaviours. Perhaps most pertinently for the present article, Baumeister, Twenge, and Nuss (2002) found that social exclusion reduced performance and 'intelligent thought'. In the current study, manipulated relatedness support was the only factor to influence objective game performance, consistent with earlier findings on the impact of exclusion versus belongingness upon cognition. In terms of the 'trade offs in outcomes' issue mentioned in the introduction, if performance/learning is viewed as the most valued outcome, then relatedness support may be the most important environmental provision of all.

Despite the afore-mentioned convergences between the current and past studies, notably, this study is the first to link the competence feedback and social exclusion experimental traditions within a broader perspective upon needs, integrating them, along with autonomy provision, under a single conceptual framework (Deci & Ryan, 1991). The empirical results of this integration indicate that prior findings concerning the negative effects of social exclusion (Twenge & Baumeister, 2005) occur through processes that are independent of competence and performance issues (Wallace & Baumeister, 2002), and similarly, that the effects of low authority expectancies and failure feedback are not simply reducible to lowered feelings of social connection (Harackiewicz & Sansone, 2000). Thus, each type of contextual support (or hindrance) induces a specific experience that carries the effects of the contextual factor, rather than inducing a general negative state of mind. Also, this study shows that there are no interactive relations between social exclusion and failure feedback, the first such demonstration. In terms of extending SDT itself, the current study integrates the social-experimental and self-report correlational findings within this tradition (Deci & Ryan, 1991), by manipulating all three needs (rather than just one need), and by showing that the social-contextual factors produce corresponding self-reported feelings which in-turn carry the factor effects upon outcomes. We believe that such integration is overdue and timely.

Finally, it is worth considering the results concerning the neutral control group. The means for this group for the most part did not differ from those of the need support groups, as the omnibus main effects were largely accounted for by the contrast between the neutral control group and the need-deprivation groups. Given that most college students report high baseline levels of all three needs (Sheldon *et al.*, 2001), it may be that explicitly supporting needs has few incremental effects, whereas problems can arise when the authority in the situation appears to undermine or threaten one's needs. It may also be that seemingly negative behaviours on the part of the experimenter are simply more unexpected or memorable.

Study limitations include the fact that the autonomy, competence, and relatedness manipulations were somewhat global and may have implicated other processes besides the ones that SDT postulates. For example, the supportive conditions all employed positive statements and the non-supportive conditions employed negative statements, perhaps accounting for the results. Still, the distinctive pattern of condition effects upon

the manipulation check variables and the mediation of the condition effects via the manipulation check variables indicate that the manipulations were reasonably specific in their effects. Another potential study limitation concerns our failure to detect interactions; only one two-way interaction emerged out of 21 possible in the manipulated-satisfaction MANOVAs, and no two-way interactions emerged out of 12 possible in the rated-satisfaction regressions. Again, SDT tends not to predict such interactions, but still, one might plausibly expect some to emerge. For example, perhaps relatedness ('I care about you') should be less beneficial if administered in a controlling way ('but in this experiment you must do exactly as I say'). Future research with more tailored manipulations may be required to substantiate such synergistic (i.e. interaction) hypotheses. At the very least, the present research clearly shows the additive effects of having multiple needs satisfied, as participants in the condition in which all three needs were supported manifested the best outcomes, overall.

In conclusion, this study provides a new type of support for SDT's postulate that autonomy, competence, and relatedness are distinct and uniquely important human needs. The results suggest that teachers, bosses, parents, coaches, and social mentors would be well advised to consider how their way of interacting with their charges affects the subjective state of those charges. Anything that makes them feel less autonomous, competent, or related may also undermine their intrinsic motivation for the activity, as well as potentially undermining their objective performance at that activity.

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