



The association of autonomy support on memory need satisfaction and goal progress

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Abstract

Self-defining memories reflect our enduring concerns (past and present) and our desired future outcomes. One of the important characteristics of self-defining memories is need satisfaction, such that the higher level of satisfaction of the needs for autonomy, relatedness, and competence in memories positively predicts well-being and relationship satisfaction. Based on past research showing that autonomy supportive environments promote need satisfaction, we hypothesized that autonomy support would lead to greater goal-related need satisfying memories which would in turn promote goal progress. We conducted three prospective studies to test our hypothesis. Participants were asked to list a current goal, and to rate perceived autonomy support from a significant other and their goal progress. They were also asked to select and describe a significant memory related to the goal and rate the extent to which they felt competent, autonomous and related in the memory. We found that changes in need satisfaction in goal-related memories over time mediated the relationship between autonomy support and goal progress. This paper highlights how interpersonal support can influence self-regulation by shaping self-defining memories.

Keywords Self-determination theory · Goals · Autonomy support · Autobiographical memories

Humans are naturally goal-oriented and constantly working towards a desired outcome be it completing a long-overdue article or watching the final season of *Game of Thrones*. There are countless articles to help you accomplish your goals like “5 tips to reach your career goals quicker” (Blank 2019), or even a step-by-step guide “How to accomplish a goal: 15 steps (with pictures)” (Rube 2019). From implementation intentions (Gollwitzer 1999; Gollwitzer and Sheeran 2006) to motivational talks (Wilson 2008), we are determined to find the best way to achieve our goals. According to self-determination theory, our goal progress is influenced not just by what we do, but also by what we receive. There are three fundamental psychological needs that must be fulfilled to achieve optimal psychological functioning (Deci and Ryan 2000). The need for autonomy refers to the need to be self-determined and authentic; the need

for relatedness refers to the need to feel connected to others; the need for competence refers to the need to feel self-efficacious. The extent to which people are able to satisfy these needs and thrive psychologically depends significantly on whether the social environment provides opportunities for these needs to be met (an autonomy supportive environment), or not (a controlling environment). Past research has shown that autonomy support increases need satisfaction for autonomy, competence, and relatedness, which in turn facilitates goal progress (Vasquez et al. 2016; Koestner 2008; Smith et al. 2007). However, it is not entirely clear how this form of support affects associated goal structures (e.g., Conway et al. 2004; Kruglanski et al. 2002) and orients behaviors toward effortful progression toward a goal. The present study investigates how the experiential component of a cognitive goal-related structure—autobiographical memories—can be altered by autonomy support to influence goal progress.

Autonomy support provides an environment where an individual feels secure and validated by the support provider. The recipient knows that the provider’s support is not contingent on compliance but rather there is a genuine positive regard for the self. This support is characterized by the provider empathizing with the recipient’s feelings and situation,

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providing choice whenever possible, giving a rationale for requests, and being responsive to the recipient (Ryan and Deci 2001; Joussemet et al. 2008). For instance, John supports his partner Jenn in her pursuit of her academic goal by listening to her concerns about her goal, being understanding about the difficulties she faces and caring for her as a person beyond just her goal. Consequently, Jenn feels valued as a person and that she can be open with John, even when she fails to make progress in her goal.

Broadly, goals are defined as aspirations or desirable outcomes. Hulleman et al. (2010) defined achievement goals as “a future-focused, cognitive representation that guides behavior to a competence-related (mastery or performance) end state that the individual is committed to either approach or avoid.” (p. 423). Goals can also be viewed more generally as life goals or aspirations (Deci and Ryan 2000; Kasser and Ryan 1996). These are categorized as extrinsic (e.g., fame, financial success) or intrinsic (e.g., health, personal growth) life orientations. Importantly, autonomy support is beneficial to both achievement goals (Benita et al. 2014) and broader life goals (Weinstein et al. 2012).

There are several mechanisms by which autonomy support facilitates goal progress. First, autonomy support promotes goal attainment by increasing autonomous motivation. When people feel supported, they are more likely to pursue their goals because they find them personally important and enjoyable and not because they are forced to or out of guilt (Deci and Ryan 2000; Koestner 2008; Vansteenkiste et al. 2004). Second, autonomy support facilitates the internalization of goals. When people are supported, they are better able to integrate their goals with their values, and pursued them from an internal perceived locus of control (Sheldon and Elliot 1999). Third, autonomy support increases the effectiveness of goal pursuit. As autonomous motivation increases, people put in more effort in their goal pursuit and use more effective techniques in pursuing their goals (e.g., using implementation intentions) (Koestner 2008; Koestner et al. 2002; Sheldon and Elliot 1999). We proposed yet another way autonomy support can further goal progress—by shaping self-defining memories.

Memory and goals

Autobiographical memories represent the core experiences in an individual’s life, which are told and retold by the individual to himself and to others, and are preserved over an extended period of time. One particular type of autobiographical memories which relate to an individual’s enduring goals and concerns is termed self-defining memories (Blagov and Singer 2004; Singer and Salovey 1996). These memories are central to an individual’s concerns and

goals, and are uniquely related to self-understanding and self-discovery.

Conway et al. (2004) proposed that self-defining memories play a crucial role in defining and maintaining important long-term goals relevant to the self. Their model suggests that when a person selects or invests in a new important life goal, new self-defining memories are selected from the existing autobiographical knowledge base to better correspond with the new self. As such, the content of self-defining memories related to one’s current goals reflects the motivational quality of one’s goals. Although memories are often thought of as cognitive structures of past events, memories also serve future prospectives directly (Addis et al. 2007). The primary adaptive advantage of remembering the past is to equip an individual to prepare for the future—anticipating future events and preparing for future challenges. Indeed, both activities (remembering the past and imagining the future) engage the same brain regions, rely on the same neural network, and recruit the same cognitive structures (Demblon and D’Argembeau 2016; Schacter and Addis 2009). For instance, the medial prefrontal cortex (mPFC) is one of the most commonly activated regions in both the recollection of autobiographical memories and prospective thinking (Demblon et al. 2016). This suggests that the mPFC serves to connect and integrate specific events to higher order conceptual autobiographical knowledge such as personal goals. In both function and biology, memories connect the past to present concerns and link to future actions. We hypothesize that autobiographical memories are associated with goal progress as these memories highlight current concerns and organize attention and efforts towards achieving one’s desired outcome (Conway and Pleydell-Pearce 2000; Johnsen and Berntsen 2010; Klinger and Cox 2011).

Consistent with our postulate, research has shown that affective quality of self-defining memories predicts personal strivings. For instance, the more positive people’s memories were about their goals, the more confident and the more committed they were to attaining their goals (Moffitt and Singer 1994; Sutin and Robins 2008). Students who were randomly assigned to recall a positive memory that would increase their motivation to exercise (compared to a negative memory or a control condition) were more likely to exercise a week later (Biondolillo and Pillemer 2015). Specific goal-related self-defining memories also direct and guide relevant intentions and behaviors. For instance, students’ specific memory of being satisfied or dissatisfied with their university implicitly influenced their intentions to donate to their university, above and beyond their general attitude towards their university (Kuwabara and Pillemer 2010).

An important component of self-defining memories orienting behaviors beyond affect appears to be the level of need satisfaction characterizing those memories (Philippe et al. 2011, 2012). The level of need satisfaction

in self-defining memories positively predict important outcomes such as emotion regulation (Philippe et al. 2011), well-being (Philippe et al. 2012), and quality of romantic relationships over time (Philippe et al. 2013), above and beyond affective valence, other memory characteristics, and personality traits.

Memories and autonomy support

In this study, we examine how autonomy support may influence goal progress by shaping goal-related self-defining memories. More specifically, we expected that autonomy support should facilitate the election of goal-related self-defining memories characterized by greater need satisfaction. In turn, these need satisfying memories should lead to an increase in goal progress.

There is indirect support for the above postulated sequence and for the relationship between autonomy support and the formation of need satisfying memories in the literature on child development. This research emphasizes the importance of autonomy support in narrative development, which is a child's ability to describe and connect past events into a coherent story. Maternal autonomy support promotes recall (Cleveland and Reese 2005) and engagement in narrative recall (Cleveland et al. 2007; Leyva et al. 2009). Importantly, developed narrative processing is required to form coherent autobiographical memories and construct their own life story (Habermas and Bluck 2000), which subsequently facilitates the organization of actions that allow for the pursuit and attainment of specific goals (Fivush et al. 2006; Conway et al. 2004; O'Neill et al. 2004).

It is important to note that we expect the psychological quality of the goal-related memories to change, not the events recalled or the accuracy of the memories. Memories are not static and naturally change over time. McAdams and his colleagues found that people repeated only 28% of their original 10 key memories three months later, and 22% of their original key memories three years later (McAdams et al. 2006). Despite the change in autobiographical content, however, there was high continuity in emotional tone and narrative complexity, reflecting self-integration and personal growth. For example, an individual may recall a memory when his father scolded him for failing an exam at Time 1 and a memory of receiving his exam grades at Time 2. It is also possible, however, that he recalls the same event twice—his father talking to him about failing his exam. How he perceives these events is more important than the event itself. That is, although the same event is recalled, he might view his father as critical of his grades at Time 1 but view his father as being concerned for his academic achievement at Time 2. It is not the event that changed, but the experience of the event. Thus, the individual re-authors his memory

to identify and/or generate alternative narratives which are more need satisfying (White and Epston 1990). This change in need satisfaction of a goal-related memory is likely to have a directive function that will sustain one's effort and drive goal progress forward.

Therefore, we predicted that changes in need satisfaction in autobiographical memories would mediate the relationship between autonomy support and goal progress. In other words, autonomy supportive environments should promote goal progress via changes in memory need satisfaction.

The present research

The purpose of the present research was to investigate the cognitive mechanisms involved in the relationship between autonomy support and goal progress. We hypothesized that perceived autonomy support from a close other will facilitate the selection, recruitment, and reconstruction of more need satisfying goal-related autobiographical memories, which in turn, will monitor and facilitate goal progression. Three longitudinal studies were conducted to examine this hypothesized sequence. In Study 1, we examined autonomy support received from a romantic partner and goal progress was measured three months later. In Study 2, we examined autonomy support received from a friend for an academic goal and goal progress was measured two weeks later. In Study 3, we compare autonomy and directive support from a significant other on goal progress during the winter holiday break. In all three studies, we hypothesized that autonomy support from a close other would increase need satisfaction in goal-related autobiographical memories. Autonomy support was expected to lead to changes in need satisfaction in goal-related autobiographical memories, which would subsequently lead to goal progress.

It is also possible that people who are more motivated are just more likely to increase in need satisfaction, such that positivity begets positivity. This alternative explanation posits that autonomy support does not lead to changes in need satisfaction, but rather individuals who are already motivated to pursue their goals will have more positive memories associated with their goals. To account for this possibility, motivation is controlled in Study 2, and goal self-concordance and goal commitment is controlled in Studies 1 and 3.

Study 1

Study 1 was part of a larger study on goals and support. We tested our hypothesis over three months using self-selected personal goals. The study used a dyadic design, where both members of a romantic dyad report on their memories, motivation, and goal progress. We expected to find that if the

actor perceived his partner to be autonomy supportive, s/he would report greater goal progress as the memories become more need satisfying (actor effect). However, we did not expect to find a partner effect—that the partner’s need satisfaction or goal progress would be affected by actor’s perceptions of autonomy support (partner effect).

Method

Students of a Malaysian university in dating relationships were invited to participate in the study in exchange for extra credit. As a former British colony, English continues to be widely used in Malaysia and is the language of instruction in majority of private education institutions. Thus, as the participants were recruited from a private university whose language of instruction is English, the questionnaires were administered in English. A power analysis showed that to detect a moderate effect size of $r = .30$, R^2 of .09, a n of approximately 60 dyads would be needed to obtain statistical power at a .70 level (Stevens 2009). In total, 81 heterosexual couples (162 participants) completed Time 1 and 73 couples (146 participants) completed Time 2, three months later ($M_{\text{age}} = 21.78$, $SD = 2.41$). In Time 1, participants described a memory of a personal goal and completed measures of memory need satisfaction, perceived partner’s autonomy support, and self-concordance. At the end of term, three months later, they were invited to complete a follow-up questionnaire. They were reminded of their goal and asked to describe again an important memory associated with their goal. They were asked to describe any memory that spontaneously came to mind, regardless of whether it was the same or different memory as what they had listed down at Time 1. They again rated the level of need satisfaction characterizing their memory. Participants’ rated levels of need satisfaction in memories have been found to be an equivalent predictor of outcomes compared to coders’ rated levels of need satisfaction in memories, and highly correlated with each other ($r = .70$) (Philippe et al. 2011). Finally, participants reported on their own goal progress.

Measures

Goal selection

Participants were given the instructions to: “think about a goal that you have independent from your partner. This should not be a shared goal, one that you mutually set with him/her. Your partner could be involved in some way, but this should be your own goal”. Participants could choose any personal goal they wanted. Examples of goals were “To be more expressive, confident and a little more extrovert” or “Involve in activities that can benefit the society (charity,

foundations, NGOs, etc.).” After participants nominated a goal, autobiographical memories and need satisfaction of the memory was measured.

Goal memory and memory need satisfaction

Participants were asked to think about a goal-related memory. The instructions were derived from past research (e.g., Philippe et al. 2012; Sutin and Robins 2008) and detailed in Online Appendix A. After the participants described the memory, they were presented with the following stem (“Think back to how you experienced the event of the memory that you described when it occurred and respond to each of the following statements”) before responding to the following items to describe the extent to which they felt autonomy (e.g., “I felt free to do things and think how I wanted”), competence (e.g., “I felt competent”) and relatedness (e.g., “I felt connected to one or more people”) when the event of their memory occurred (Philippe et al. 2011, 2012). The Cronbach’s alpha for the measure was .79 for Time 1 and .62 for Time 2.

Autonomy support

At Time 1, participants were asked to think of the way their romantic partner supports their goal pursuit. They completed a six-item measure of autonomy support (e.g., “My friend listens to how I would like to do things about my academic goal”) using a 7-point Likert scale (1 = *Strongly disagree*; 7 = *Strongly agree*) (Koestner et al. 2012). The Cronbach’s alpha was .83.

Self-concordance

Participants completed the 4-item self-concordance measure in which they rated the extent to which they were pursuing their goals for controlled or autonomous reasons (Sheldon and Kasser 1995). The inter-item correlation for autonomous reasons was .55 and the inter-item correlation for controlled reasons was .61. A total self-concordance score was calculated by subtracting the controlled reasons score from autonomous reasons score.

Goal progress

At the end of semester, at Time 2, participants reported how much progress they made on their goal on a three-item measure (“I put a lot of energy and effort into achieving this goal”, “In the future, I am likely to reach this goal” and “I am satisfied with the progress I am making towards this goal”). Each item was rated on a 7-point scale (1 = *Strongly disagree*; 7 = *Strongly agree*). The Cronbach’s alpha was .68.

Table 1 Means, standard deviations and correlations for Study 1

	<i>M_{male}</i> (<i>SD</i>)	<i>M_{female}</i> (<i>SD</i>)	1	2	3	4	5
1. Time 1 Autonomy support	5.48 (1.05)	5.50 (.91)	–	.10	.45**	.36**	.13
2. Time 1 Self concordance	3.99 (7.02)	4.42 (7.43)	.10	–	.20	–.02	.03
3. Time 1 Memory need satisfaction	5.09 (.99)	4.86 (.98)	.29**	.28*	–	.51**	.28*
4. Time 2 Memory need satisfaction	5.56 (.91)	5.08 (.92)	.27*	.04	.32**	–	.51**
5. Time 2 Goal progress	5.48 (1.04)	5.14 (1.06)	.33**	.04	.18	.31**	–

Correlations for males are above the diagonal, correlations for females are below the diagonal

p* < .05; *p* < .01

Results

We first assessed for actor/partner effects. The analyses showed there was only an actor-only pattern effect.¹ Thus, the partner pathways were set to 0. Means, standard deviations and correlations are presented in Table 1. According to the recommendations of Kenny et al. (2006), all predictors were centered on the grand sample mean scores. The degree of nonindependence was estimated by calculating the intra-class correlation for all variables. The intraclass correlation for all variables were positive and small to moderate (ranging from .05 to .30 with an average of .18).

Sample memories of participants who reported receiving low autonomy support at Time 1 reflected low autonomy (“I am too tired to fight”) and low relatedness (“he didn’t really show interest when we came to that topic”). After three months, the memory associated with the goal was still low in need satisfaction (competence: “my plan of study... might not be achieved”; relatedness “He didn’t show interest”). A sample memory from a participant who experienced high autonomy support at Time 1 showed experiences of relatedness (“my partner has been supportive and understanding”) and competence (“I am able to achieve my goal

in the future”). It also contained experiences of not feeling competent and good enough. After three months, the participant’s memory reflected experiences of need satisfaction (relatedness: “my partner understands and respect my decision”; competence: “I will definitely be a working mother in the future”, “I want to be really successful in my career”: autonomy: “I want the same... since young, I have this goal...”). See Online Appendix B for sample narratives from Studies 1 and 2. We coded for change in memories and only 13.8% reported the same memory at Times 1 and 2. This is consistent with past research wherein only 8.5% of participants reported the same memory in a longitudinal design (Bouzigarene and Philippe 2016). There were no differences in the study variables between participants who reported the same memory or a different memory.

We ran the full model in Mplus 8 (Muthén and Muthén 1998–2017) using a multilevel structural equation modeling (MSEM), allowing us to test for actor effects and the mediation model. Figure 1 shows the hypothesized model with only the significant paths displayed. The fit indices were: $\chi^2(25) = 18.77, p = .81$; RMSEA = .00 (90% CI = .00; .042); CFI = 1.00. Autonomy support significantly predicted changes in memory need satisfaction, which in turn predicted self-reported goal progress. Self-concordance was not significantly related to goal progress. The significance of the mediational effect was tested by examining the 95% bias-corrected bootstrapped CI based on 5 000 simulated draws for the *a* and *b* parameters. The bootstrap bias-corrected 95% indirect effect from autonomy support to goal progress through changes in memory need satisfaction was significant with *B* = .071 (*SE* = .34), 95% CI [.022; .13]. There was no difference in the results when we controlled for age.

Study 2

Study 2 focused on a different type of goal (academic goals) and a different type of relationship (friendships). We also measured goal progress at the beginning and at the end of the study which allowed us to focus on what specifically occurred between Times 1 and 2, unconfounded with any initial progress, as students might have already been working

¹ To assess for actor and/or partner effects, we estimated the *k* parameter using SEM conducted in Mplus (Kenny and Ledermann 2010; Fitzpatrick et al. 2016). The *k* parameter is used to test for specific dyadic patterns and is calculated by measuring the ratio of the partner effect to the actor effect. If *k* is equal to 1, this indicates a couple pattern where both actor and partner effects are significant. If *k* is equal to 0, this indicates an actor-only pattern, where only actor effects are significant. If *k* is equal to – 1, this indicates a partner-only pattern, where only partner effects are significant. We examined this in two analyses reflecting the relationship between the dependent variable (autonomy support) and the mediator (Time 2 memory need satisfaction) and the relationship between the mediator (Time 2 memory need satisfaction and the outcome measure (goal progress). The first analysis showed *k* = 0.317 with a CI from – 0.317 to 0.704, reflecting an actor-only pattern in the autonomy support to Time 2 memory need support pathway. The second analysis showed *k* = 0.180 with a CI from – .0110 to .0531, reflecting again an actor-only pattern in the Time 2 memory need satisfaction to goal progress pathway. As the results showed that partner effects were null, we set partner pathways to 0.

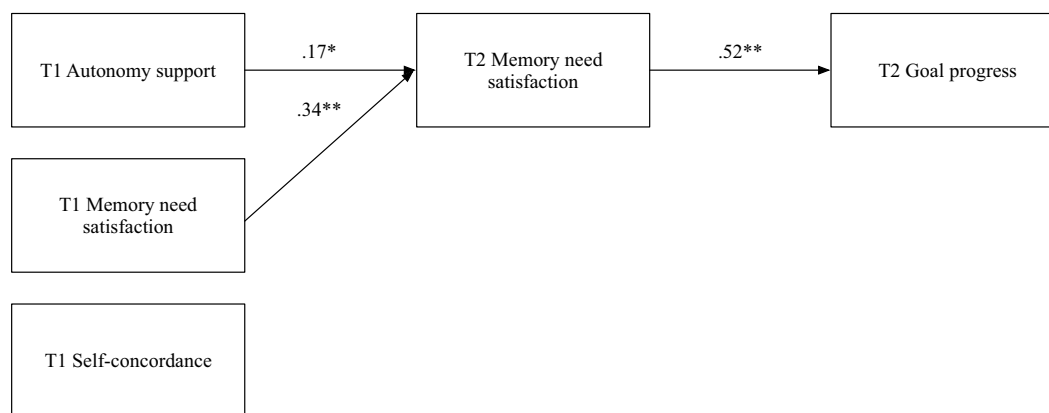


Fig. 1 Study 1 model showing the relationship between autonomy support and goal progress as mediated by changes in memory need satisfaction over 3 months. Unstandardized coefficients are shown

with the standard errors in parentheses. Non-significant paths are not shown for clarity. * $p < .05$; ** $p < .01$

on their academic goals. In Study 2, students were asked to think of a close friend and describe an academic goal they had. They then rated the extent to which this friend was autonomy supportive with respect to their goal. They were also asked to describe an important autobiographical memory related to their goal in some way. Two weeks later, they were asked to report again a memory related to their goal (same or different) and to report on their goal progress. It was hypothesized that perceived friend's autonomy support would lead to increases in need satisfying goal-related memories over time, which would be in turn associated with goal progress. Since there were no significant dyadic partner effects in Study 1, it was deemed unnecessary to use a dyadic design in the present study.

Method

Participants and procedure

This is part of a larger study on support and goals. Participants were recruited from the same private university as Study 1 for extra course credit. A power analysis showed that to detect a moderate effect size of $r = .30$, R^2 of .09, a n of approximately 60 would be needed to obtain statistical power at .70 level (Stevens 2009). Eighty-seven participants completed Time 1 and 57 participants completed the follow-up questionnaire 2 weeks later at Time 2. There were no mean differences in the variables of interest between the participants who completed the follow-up questionnaire and the participants who only completed the Time 1 questionnaire. Final sample was composed of 85% of females aged 20 years on average ($SD = 2.99$).

Measures

Goal memory and need satisfaction

Participants were asked to write their academic goal for the semester. Examples of academic goals are "To graduate with a First Class Honours" and "To get good results and score a CGPA of 3.5". The same methodology as used in Study 1 was used to measure memories and need satisfaction.

Two weeks later, participants were asked to again provide a memory associated with their academic goal that is older than three months old, as we wanted them to recall established goal-related memories, rather than recently formed memories in the two week period. They were also asked to rate their felt need satisfaction of the event Time 1: $\alpha = .66$; Time 2: $\alpha = .65$).

Autonomy support

At Time 1, participants were asked to think of a friend they were close to. They completed the same six-item measure of autonomy support as in Study 1. The Cronbach alpha was .92.

Motivation

At Time 1, participants completed a 16-item scale (Valle-rand et al. 1989) on academic motivation which taps into the reasons why they are in university (e.g., "Because with only a high-school degree I would not find a high-paying job later on"). A total motivation score was created by subtracting controlled motivation scores (introjected and extrinsic) from autonomous motivation scores (intrinsic and identified) (Koestner et al. 2008; Ryan and Connell 1989). The

Table 2 Means, standard deviations and correlations for Study 2

	<i>M (SD)</i>	1	2	3	4	5	6
1. Time 1 Autonomy support	5.79 (.79)	–					
2. Time 1 Motivation	27.19 (2.48)	.41**	–				
3. Time 1 Memory need satisfaction	4.63 (.98)	.23	.03	–			
4. Time 1 Goal progress	4.89 (.95)	.03	.34**	.31*	–		
4. Time 2 Motivation	22.34 (2.75)	.48**	.69**	.14	.20	–	
5. Time 2 Memory need satisfaction	4.90 (.86)	.47**	.28*	.53**	.27*	.26	–
7. Time 2 Goal progress	5.05 (1.17)	.19	.31*	.27*	.71**	.21	.52**

* $p < .05$; ** $p < .001$

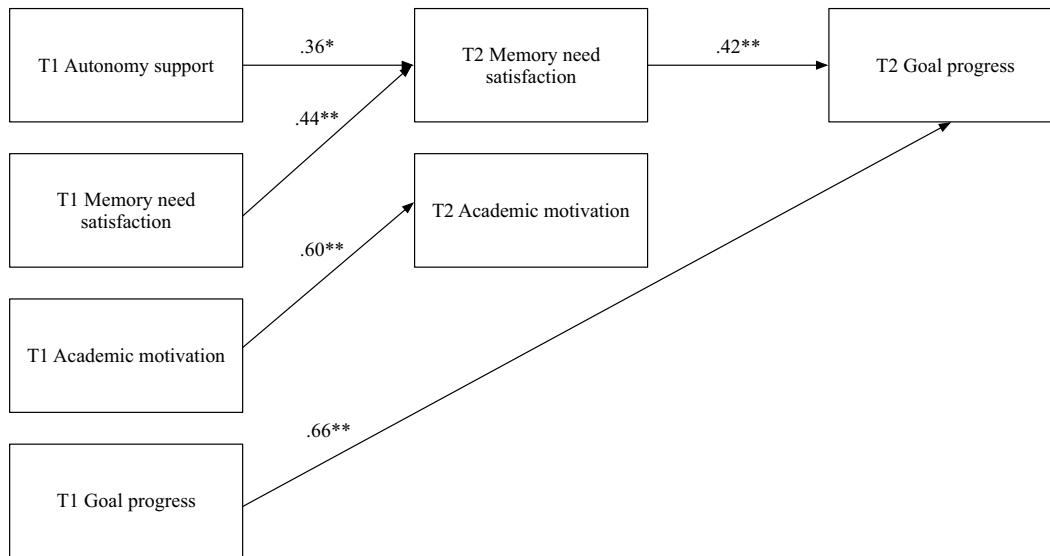


Fig. 2 Study 2 path analysis model of the associations among autonomy support, Times 1 and 2 memory need satisfaction, Time 1 and Time 2 academic motivation, and Times 1 and 2 goal progress. Non-significant paths are not shown for clarity. * $p < .05$; ** $p < .01$

Cronbach’s alpha for autonomous motivation subscales and controlled motivation subscales was .84 and .79 respectively.

Goal progress

At the start and at the end of the study, participants reported on their goal progress on a 3-item scale (“I am making good progress on my academic goal”, “I am satisfied with the progress I am making on my academic goal” and “I put a lot of time and effort into pursuing my academic goal”) (Time 1: $\langle = .66.$; Time 2: $\langle = .89$). This measure has often been used as a self-report goal progress measure (e.g., Koestner et al. 2012).

Results

Means, standard deviations, and correlations are reported in Table 2. Sample narratives can be found in Online Appendix B. Given the small time span between the two measurement points as compared to Study 1, 52.6% reported the same memory at Times 1 and 2. Importantly, there were no differences in the variables of interest between participants who reported the same memory or a different memory.

A path analysis using Mplus 8 (Muthén and Muthén 1998–2017) was conducted to test the hypothesized mediation model. The model included five exogenous variables, that is, Time 1 autonomy support, Time 1 memory need satisfaction, Times 1 and 2 academic motivation and Time 1 self-reported goal progress. All these variables were modelled to predict memory need satisfaction at Time 2, which in turn predicted goal progress at Time 2. All Time

Table 3 Means, standard deviations and correlations for Study 3

Variables	<i>M (SD)</i>	1	2	3	4	5	6	7
1. T1 Autonomy support	6.11 (0.83)	–						
2 T1 Directive support	4.81 (1.32)	.45**	–					
3. T1 Memory need satisfaction	.62 (1.67)	.07	– .13	–				
4. T2 Memory need satisfaction	1.07 (1.53)	.30*	.04	.53**	–			
5. T1 Goal commitment	6.12 (0.87)	.43**	.21*	.01	.13	–		
6. T1 Goal concordance	1.77 (2.15)	.19*	.02	.25*	.40**		–	
7. T1 Goal progress	13.17 (6.44)	.09	.07	.07	.15	.05	.06	–
8. T2 goal progress	8.09 (6.42)	.08	.01	.14	.27*	.15	.02	.46**

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

1 variables were also modelled to predict Time 2 variables to control for their influence. The model was tested using robust maximum likelihood as the estimation method. The model was just identified and, therefore, the fit indices were saturated (see Fig. 2).

The results showed that Time 1 autonomy support, Time 1 memory need satisfaction significantly predicted memory need satisfaction at Time 2. However, changes in academic motivation was unrelated to memory need satisfaction at Time 2. Goal progress at Time 1 positively predicted goal progress at Time 2. As expected, changes in memory need satisfaction significantly predicted changes in goal progress over time, controlling for memory need satisfaction and goal progress at Time 1.

We tested whether changes in memory need satisfaction would mediate the effects of autonomy support at Time 1 on changes in goal progress, using bootstrapped analysis with Mplus 8 (Preacher and Hayes 2008). The significance of the mediational effect was tested by examining the 95% bias-corrected bootstrapped CI based on 5000 simulated draws for the *a* and *b* parameters. The indirect effect of autonomy support Time 1 on changes in goal progress through changes in memory need satisfaction was $B = .22$ ($SE = .12$), 95% CI [.07; .47]. There was no difference in the results when we controlled for age and sex. Thus, results suggest that changes in memory need satisfaction mediated the relationship between autonomy support at Time 1 and changes in goal progress.

Study 3

Study 3 included a number of improvements over Studies 1 and 2. First, Study 3 used a more time-limited type of goal, one that could be fully achieved over a few weeks during the winter holiday break. A few days before the winter holiday break, participants were asked to describe a goal that they wanted to achieve during the break and their progress on this goal was assessed two weeks later (at the end of the holiday

period). This method delineates a short period of time that is the same for all participants and during which their goals could be achieved.

A second improvement is that Study 3 measured both autonomy and directive support. Directive support is characterized by the provision of positive guidance and reminders of what needs to be done to achieve goal success (Powers et al. 2015; Koestner et al. 2012). This is in contrast with autonomy support which is characterized by empathic and non-controlling behaviors. In line with self-determination theory (Ryan and Deci 2017), directive support was found to be unrelated with goal progress (Koestner et al. 2012). Thus, we hypothesized that only autonomy support, and not directive support, would lead to increases in memory need satisfaction.

A third improvement is that Studies 1 and 2 recruited university students only. Study 3 recruited participants from the general population of all ages, thereby increasing the external validity of our findings. A fourth improvement in Study 3 was to develop a more objective measure of goal progress to test the robustness of our findings, given that Studies 1 and 2 relied on self-reported goal progress. To gain a more objective measure of goal progress, we asked participants to report their level of goal progress in percentage ranging from 0 to 100% at both measurement time points and to report the actions or steps they have taken to achieve their goals. This allowed us to counter-verify the percentage of progress reported by the participants and to examine whether self-reported goal progress was accompanied with actual goal behaviors. In addition, this measure has the advantage of not confounding effort with progress, in contrast to the commonly used measure of goal progress that we used in Studies 1 and 2, which comprises an item pertaining to the efforts made towards goal progress.

Finally, we controlled for goal commitment which has been shown to predict goal progress in past research (e.g., Sheldon and Kasser 1998). This ensured that this variable could not be confounded with memory need satisfaction or

autonomy support. Following Studies 1 and 2, we hypothesized that autonomy support would increase need satisfaction in goal-related autobiographical memories which would in turn lead to significant increases in goal progress.

Method

Participants and procedure

Participants were 121 individuals from the general population (67.8% women) aged between 19 and 84 years old ($M = 37.35$; $SD = 12.46$) and recruited from Amazon Mechanical Turk. The study included two phases. The first phase took place before the beginning of the holiday break (December 19th) and the second phase took place after the end of the holiday break (January 9th). Participants were offered an incentive of \$0.50 CAN to complete the first phase of the study. They were informed that an additional incentive of \$3.50 CAN would be given to them after they completed the second phase of the study. We offered a greater compensation in the second phase of the study to ensure that a sufficient number of participants completed both waves of the study. All goal and memory descriptions at Time 1 were screened for data quality. Overall, there were 227 participants who completed the study. From these, 68 were rejected because the goal or memory descriptions were too short or obviously fake (e.g., copy and paste from a random website). This left 159 valid cases at Time 1. On average, participants wrote 75.71 words in their memory description, which is comparable to what other studies on memories have found (e.g., Philippe et al., 2015). At Time 2, 121 participants completed the study for a dropout rate of 24%. However, participants who fully completed the study did not differ on any of the study variables from participants who dropped out. Unless otherwise stated, items were responded to on a 7-point Likert scale (1 = *strongly disagree* 7 = *strongly agree*).

Measures

A significant holiday goal

At Time 1, participants were asked to describe a significant goal they had for the holiday season. They were told that it should be a short-term goal that they could pursue, make progress in, and achieve during the holiday break. At Time 2, they were asked again to provide their goal, so that we could check whether the goal had been forgotten or was a different goal. This ensured that the selected goal at Time 1 was important enough to be correctly recalled at

Time 2. All included participants correctly recalled their Time 1 goal.

Goal self-concordance

Participants completed the same goal self-concordance measure as in Study 2. The inter-item correlation for autonomous reasons was .41 and .35 for controlled reasons.

Goal commitment

Participants completed a 3-item scale derived from past research (Sheldon and Kasser 1998; Hollenbeck et al. 1989) that measures the degree to which individuals are committed to their goals. A sample item is "I am very committed to my goal". The Cronbach alpha was .82.

Goal progress

Participants were asked to describe the level of progress they had made with their goals by selecting the corresponding percentage of progress in a list. The options ranged from 0 to 100% in increments of 5% (i.e., 15%, 20%, 25%, etc.). Goal progress was assessed at both phases of the study. On average, participants reported having already made 35% of progress at the first phase of the study and 60% at the second phase.

Participants also listed down the steps they had taken in pursuit of their goal. Two independent coders were asked to read the goals and to assign a score rating goal progress from 0 to 5 based on the actions reported and the reported sense of having achieved the goal or not. Coders rated goal progress as 0 when no action was reported or no goal progress was reported at all; and 5 when all necessary actions were taken to achieve the goal and that the goal was achieved. Coders only had access to the goal and the steps at both times. They were blind to all other data. Interjudge reliability was $> .70$ for both Times 1 and 2 on 25% of the material. Examples of the coding of goal actions are provided in Online Appendix C.

Autonomy and directive support

Participants were asked to write down the last name of a person with whom they live or of someone close to them who is aware of their goal. They then completed a 12-item scale pertaining to that person measuring the degree to which that person supports their goal pursuit (Koestner et al. 2012). The same 6-item measure of autonomy support used in Studies 1 and 2 was used again in Study 3. In addition, we included a 6-item measure of directive support (Powers et al. 2008),

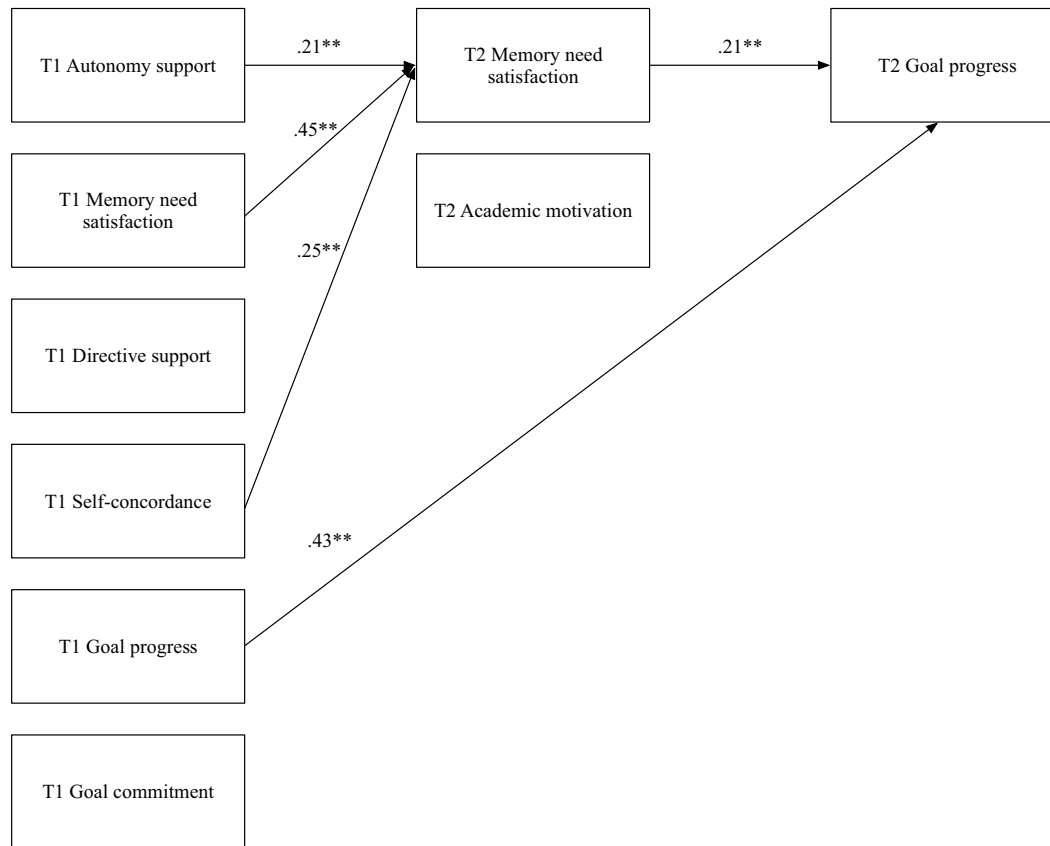


Fig. 3 Study 3 path analysis model of the associations among autonomy support, directive support, goal concordance, goal commitment, Times 1 and 2 memory need satisfaction, and Times 1 and 2 goal progress. Non-significant paths are not shown for clarity. * $p < .05$; ** $p < .01$

which refers to the degree of guidance provided by participants' goal supporter (e.g., "[Name of the person] repeatedly reminds me of my goal"). Cronbach alphas were .86 for autonomy support and .85 for directive support.

Goal memory and need satisfaction

Participants provided a memory related to their chosen goal at both Times 1 and 2. At Time 2, participants were told that the memory could be the same they had described at Time 1 or a different one, provided that the memory was related to their goal. Instructions were the same as in Studies 1 and 2, with a slight adaptation to reflect the winter break ("a significant memory related to the goal you have chosen for the winter holidays."). As in Studies 1 and 2, after describing their memory, participants were asked to rate the extent to which they felt competent, autonomous, and affiliated during the event of the memory. All items were averaged into an index measuring memory need satisfaction (Time 1: $\alpha = .92$; Time 2: $\alpha = .91$).

Results

Means, standard deviations, and correlations are reported in Table 3. A path analysis using Mplus 8 (Muthén and Muthén 1998–2017) was conducted to test the hypothesized mediation model. The model included six exogenous variables measured at Time 1, that is, autonomy and directive support, memory need satisfaction, and self-reported goal progress and two control variables, goal concordance and goal commitment. All these variables were modelled to predict memory need satisfaction at Time 2, which in turn predicted goal progress at Time 2. All Time 1 variables were also modelled to predict Time 2 variables to control for their influence. The model was tested using robust maximum likelihood as the estimation method. The model was just identified and, therefore, the fit indices were saturated (see Fig. 3).

The results showed that autonomy support, goal self-concordance, and memory need satisfaction significantly predicted memory need satisfaction at Time 2. However, directive support, goal commitment, goal progress at Time 1 were unrelated to memory need satisfaction at Time 2.

Goal progress at Time 1 positively predicted goal progress at Time 2. More importantly, changes in memory need satisfaction significantly predicted changes in goal progress over time, while controlling for memory need satisfaction and goal progress at Time 1. Controlling for age and gender did not alter these results and both were unrelated to the outcomes.

As in the previous studies, we tested whether changes in memory need satisfaction would mediate the effects of autonomy support at Time 1 on changes in goal progress, using bootstrapped analysis with Mplus 8 (Preacher and Hayes 2008). The significance of the mediational effect was tested by examining the 95% bias-corrected bootstrapped CI based on 5 000 simulated draws for the *a* and *b* parameters. The indirect effect of autonomy support Time 1 on changes in goal progress through changes in memory need satisfaction was $B = 0.40$ ($SE = 0.20$), 95% CI [0.11; 0.92]. There was no difference in the results when we controlled for age and sex. Thus, results suggest that changes in memory need satisfaction mediated the relationship between autonomy support at Time 1 and changes in goal progress.

The results were similar when using Time 2 coded goal actions as the dependent variable, controlling for coded goal actions at Time 1. Autonomy support predicted changes in need satisfaction ($\beta = .21$), which led to changes in goal progress ($\beta = .21$).

General discussion

This paper examined the effect of autonomy support on goal progress through the shaping of need satisfaction in self-defining memories. In three prospective studies, across two cultures, we found that people who received autonomy support reported greater goal-related need satisfying memories over time. Moreover, changes in memory need satisfaction was associated with goal progress. This study shows that autonomy support has the potential to shape the deeper network associations of goals, beyond conscious processes such as explicit autonomous motivation.

The findings were not explained by the individual's motivation to pursue the goal or by the individual's commitment to the goal. This suggests that the changes in memory need satisfaction is not a result of a mere positive memory bias from motivated individuals or that motivated individuals report more positive need satisfying goal-related memories but rather that there are unique specific changes in the narrative of goal-associated memories as a result of autonomy support.

Past research has found significant associations between autonomy and goal progress, but of small effect size, mostly around $r = .20$ (e.g., Gorin et al. 2014; Koestner et al. 2012). In the present research, the direct association

between Time 1 autonomy support and Time 2 goal progress was in the expected direction in all three studies and also around $r = .20$ (zero-order correlations between .09 and .33). However, the present findings highlight that memory processes are an important cognitive mediator of this association. Indeed, in all three studies, the associations between autonomy support and need satisfaction in memories, and between need satisfaction in memories and goal progress were much stronger than the one between autonomy support and goal progress. This is evidence that need satisfying memories may act as a key mediator in this relationship.

Although it is clear that self-control is greatly influenced by interpersonal relationships (Fitzsimons and Finkel 2010), there is little elaboration or understanding of this process. This study suggests that one of the means by which relationships can influence self-control is by shaping self-defining memories within the context of an autonomy supportive environment. In addition, our study showed that changes in need satisfaction in autobiographical memories was driven uniquely by autonomy support (compared to directive support), which in turn facilitates goal progress. Autonomy support, compared to other forms of support, uniquely increases access to autobiographical memories, and promotes goal progress through the promotion of holistic self-organization (Ryan and Deci 2006). This is consistent with past findings showing that the right prefrontal cortex which is involved in autobiographical and semantic memories (Gilboa 2004) is also integral to the autonomous regulation and holistic self-representations (Ryan et al. 1997). Interestingly the right prefrontal cortex is also implicated in goal progress by response inhibition, reducing negative emotion and memory inhibition (Satpute et al. 2012). Future research could examine whether autonomy support promotes change by reducing access to negative memories and downregulating negative emotions and thus allowing the inherent growth-oriented organismic tendencies to be expressed.

This paper also furthers our understanding of the relationship between memory and self-regulation. Working memory is an important part of self-regulation, particularly in sustaining one's attention on the goal and maintaining goal directed processing (Hofmann et al. 2012; Heatherton and Wagner 2011). Self-regulation can thus be strengthened through the exercise of the self-regulatory muscle, like by practicing inhibitory control (Muraven 2010; Hui et al. 2009). The current research raises the possibility that self-regulation may also be strengthened through autobiographical memories. Autobiographical memories have a directive function to aid an individual's pursuit of the goal (Leichtman et al. 2003). They keep track and monitor goal progress, increase goal relevant knowledge, and also increase accessibility of other memories that promote goal progress (Conway 2001, 2005).

The last function seems particularly promising in promoting self-regulation. For instance, students who described a positive memory were more motivated to exercise immediately after and reported higher exercise activity after a week compared to control groups (Biondolillo and Pillemer 2015). Deliberately accessing positive or need-satisfying goal-related memories may enhance an individual's ability to exert self-control and keep on track with his/her goal. This process parallels the process of psychotherapy (Singer and Salovey 1993). People use memories to make sense of the past and to reconstruct an identity that fulfils their needs. A therapist helps the client gain insight and understand the themes of their life stories, articulate, revise, and deconstruct their life narrative to develop more growth oriented narratives (Angus and Greenberg 2011). Through this process of reconstruction, they can change their negative remembered experience to one that is more positive and need satisfying.

One of the limitation of this study was that only one memory was assessed. A better control method would have been to collect two memories, a goal-related memory and a goal-unrelated memory. Only changes in need satisfaction in the goal-related memory, not in the goal-unrelated memory, would have been hypothesized to be predicted by autonomy support and to predict increases in goal progress over time. Such a design is a strong way to control for confounds related to general individual differences affecting memory encoding and reconstructive processes. However, past research (Philippe and Bernard-Desrosiers 2017; Philippe et al. 2012) has shown that each memory is highly specific and that distinct memories are only weakly associated with each other. Therefore, we are confident that the present results would not have been altered by controlling for a second goal-unrelated memory.

Consistent with past research of goal progress (Klug and Maier 2015), we used a variety of self-report measures to assess goal progress. A meta-analysis showed that self-report and objective goal measures are comparable and supported the validity of self-report goal progress measures (Gollwitzer and Sheeran 2006). Future research can focus on goals which can be more objectively measured such as weight-loss to replicate the findings of this study. In addition, it would be beneficial to aggregate goal progress across multiple goals to provide a more sensitive measure of the impact of autonomy support on goal pursuit (e.g., Koestner et al. 2002).

Another limitation of this study is that we did not collect information on ethnicity and thus were unable to test for ethnic differences. Malaysia is a multicultural countries with three main ethnicities (Malays, Chinese and Indians). Although there may be ethnic differences in the level of autonomy support received. We expect that autonomy

support would be associated with need satisfaction and goal progress across ethnic groups (Ferguson et al. 2011; Abad and Sheldon 2008). In addition, the sample sizes used in all three studies were small. Therefore, there might be small effect of some control variables that could not be detected due to the lower power. Non-significant results should therefore be interpreted with caution. Relatedly, latent variables could not be used in the SEM models because of the small sample sizes. Future research might do well in replicating the present findings with a larger sample size and by using latent variables modelling.

Future research could look at the effects of changes in need satisfaction in networked memories. Memories tend to cluster into networks of related memories and the extent to which these networked memories are need satisfying can contribute to outcomes, over and above the need satisfaction of the main memory (Philippe et al. 2011, 2012). As such, autonomy support could have a network wide effect—on the main goal-related memory and on the associated networked memories, which could enhance the effect of the main goal-related memory on goal progress.

Overall, the present research provides for the first time evidence that an autonomy supportive style can alter the selection of goal-related memories and their interpretation in terms of need satisfaction. Autonomy support, but not directive support, is one of the support styles that helps facilitating change through every day interpersonal interactions. By providing an environment that fulfils one's psychological needs, people can reshape and reconstruct their past by creating new narratives associated with their goals. In turn, the change in need satisfaction in their goal-related memories promotes goal-related behaviours. Autonomy support is beneficial beyond just situationally based motivation, but can help shape the way people remember the past and work towards the future.

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Compliance with ethical standards

Conflict of interest The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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