Psychological Need Satisfaction and the Importance of Variety-Novelty

By

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A thesis submitted to the Faculty of Graduate and Postdoctoral Affairs in partial fulfillment of the requirements for the degree of

Master of Arts

in

Psychology

Carleton University

Ottawa, Ontario

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Abstract

The present study investigates the plausibility of novelty-variety as a potential basic psychological need in a series of three studies. We followed set criteria proposed by Baumeister and Leary (1995) on the requirements of basic needs and explored novelty-variety within its framework. More specifically, we examined whether novelty-variety is distinct from other established needs, whether it predicts well-being outcomes, and if its absence results in adverse effects. In study 1, participants (N=202) rated novelty-variety and 10 other candidate needs (competence, autonomy, relatedness, self-esteem, self-actualization, physical thriving, security, pleasure-stimulation, popularity-influence, and money-luxury) to measure the degree to which novelty-variety uniquely predicts domain well-being. In study 2 (N=399), the fulfillment of novelty-variety and two other Self-Determination Theory (SDT) needs was experimentally manipulated in work-related vignettes and it was hypothesized that unsatisfied novelty-variety would reduce well-being. Finally, the third study (N=414) aimed to replicate the findings in study 2. All three studies provide support towards novelty-variety as a potential basic psychological need.

Acknowledgements

I would first like to thank my thesis advisor Dr. Marina Milyavskaya of the Department of Psychology at Carleton University. She allowed me the freedom to pursue a topic of my passion and I would like to express my gratitude for all of her guidance along the way. I have learned so much and have developed a deeper appreciation not only for the topic that I pursued, but also for more advanced statistics. Perhaps more importantly, I would like to thank her for embodying this line of work (on the importance of well-being and motivation) both in her professional and personal life.

I would also like to express my gratitude to my parents for providing me with unfailing support and continuous encouragement throughout my years of study. This accomplishment would not have been possible without them. Thank you.

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1 Chapter: Overview of Basic Psychological Needs

1.1 Basic psychological need theories

Basic psychological needs can be defined as an innate energizing force that propel actions that are aimed to satisfy them. If not fulfilled, they have many adverse consequences for a diverse range of mental health outcomes (Ryan & Deci, 2000). As such, basic psychological needs are fundamental to our well-being and adjustment in life. They also have important implications for behaviour and motivation. Need theories have long speculated about basic psychological drives and propose that all humans strive for experiences that fulfill basic needs (Baumeister & Leary, 1995). Need theories are useful because they offer a unifying principle to explain a wide range of motives and conducts (Baumeister & Leary, 1995). Motivation and behaviour can be explained by the psychological needs one seeks to satisfy and can be used to unify and anchor human behaviour (Sheldon et al. 2001). Furthermore, need theories can be utilized to achieve important outcomes that promote well-being and optimal functioning in many different areas of life (see Deci & Ryan, 2000; Aron, Norman, Aron, McKenna & Heyman, 2000).

Social scientists have long speculated about which psychological needs are fundamental, and various psychological need models have been proposed to date highlighting the importance of different motivational drives as basic psychological needs (i.e., Maslow, 1943; Deci & Ryan 2000). For example, in Maslow's Hierarchy of Needs (1943), the importance of physiological, safety, love-belonging, esteem, and self-actualization has been advocated as basic needs. However, in Self-Determination Theory (SDT) (Deci & Ryan 2000), humans only require three fundamental needs (competence, autonomy, and relatedness). In this, Maslow's Hierarchy of

needs and SDT only share in common the need for close connection and propose different drives as fundamental in their models. This lack of cohesion is common between psychological need theories and create a dilemma in understanding and addressing problems aimed at creating optimal outcomes.

As an effort to unify need theories and to determine which needs are most important, Sheldon, Elliot, Kim, & Kasser conducted a study in 2001 and combined the most prominent and popular needs theories together. They drew from motivation, personality, humanistic, social psychology and also included the lay theory of the "American Dream". They consolidated the overlapping needs between the theories, such as the construct of connectedness from Maslow's Hierarchy of Needs, relatedness from SDT and Epstein's Cognitive-Experiential Self-Theory (1990), and arrived at the following 10 candidate needs: *autonomy, relatedness, competence, physical thriving, security, self-esteem, self-actualizing, pleasure-stimulation, money-luxury, and popularity-influence*. They then asked adults to describe their "most satisfying life event" and to rate the salience of these 10 candidate needs within the event to observe which needs would be the most important indicators of satisfaction. In support of SDT, they found the needs for autonomy, relatedness and competence to rank amongst the top four most important predictors of satisfaction in their study.

1.2 Self-Determination Theory

Self-Determination Theory (SDT) is a theory of personality and motivation which states that autonomy, competence, and relatedness are fundamental psychological drives that must be satisfied for optimal functioning and well-being in life (Deci & Ryan 2000). SDT conceptualizes the need for *competence* to be a feeling of capability in one's actions (i.e., to feel that one has the capability and the skills to master the challenges of life). Furthermore, the need for *autonomy* is

to feel that one is instrumental in the outcomes of one's own life and is the catalyst of one's own behaviours (i.e., to identify with and to endorse one's own actions and outcomes). Finally, the need for *relatedness* is to feel connected to others and to form meaningful relationships (i.e., to feel accepted and close to those that one cares about).

Many empirical studies support the vital role of the SDT needs on many important outcomes. For example, their effects have been implicated in improving daily and domain well-being (e.g. Reis, Sheldon, Gable, Roscoe, & Ryan, 2000; Milyavskaya & Koestner, 2011), in developing secure relationship attachments (e.g. La Guardia, Ryan, Couchman, & Deci, 2000) and on effective work performance (e.g. Baard, Deci, & Ryan, 2004), to name a few. The importance of autonomy, competence, and relatedness have also been measured in longitudinal studies, showing the accumulation of these experiences over time mediating a wide variety of positive outcomes (i.e., Sheldon & Elliot, 1999; La Guardia et al., 2000). In this, empirical evidence demonstrates that the need for autonomy, competence, and relatedness each operate and contribute independently to various outcomes. In other words, each SDT need has unique predictive abilities. For example, it has been well-established that having close connections with others increases well-being and satisfaction in life, and when close relationships are compromised, it has negative consequences in those areas (i.e., La Guardia, Ryan, Couchman, & Deci, 2000; Sheldon & Gunz 2009). It has also been well-established that feeling competent and capable in performing tasks predict better performance and well-being on those tasks (i.e., Baard, Deci, & Ryan, 2004). Although the need for autonomy is more controversial, there is a growing number of studies that show the advantages of autonomy in different environments and on motivational outcomes (i.e., Black & Deci, 2000; Schunk, Pintrich, & Meece, 2008). In this, SDT is an additive model requiring all three needs to be satisfied (see Sheldon & Filak, 2008).

1.3 Towards a more comprehensive model

Although there is much support for the importance of the three proposed SDT needs, there is room to speculate that these motives do not fully encompass all human basic psychological needs. One reason for this speculation arises from the tendency of the SDT needs to be measured only in a given situation (i.e. in Sheldon et al. 2001 study), which leave room for other potential drives to be overlooked due to methodological limitations. The second reason comes from looking into the literature on the importance of novelty-variety (we will present the research in detail later in this paper). Moreover, one can imagine situations in which all three SDT needs are met, yet well-being is compromised. For example, in a hypothetical situation in which one feels capable at work (i.e., all important tasks have been mastered), feels autonomous (i.e., has control over career choice and schedule), and has a good relationship with co-workers, novelty-variety may play an essential role for growth. In this, it is possible to experience a decline in one's well-being and satisfaction overtime without the presence of novelty-variety. Indeed, research suggests that engaging in routine tasks can lead to boredom, dissatisfaction, and disengagement (Tze, Daniels, & Klassen; 2015, Smith, 1981, Daschmann et al., 2011). If so, undermining the importance of novelty-variety may have negative effects on one's quality of life, even when the three SDT needs are satisfied.

1.4 Conceptualizing novelty-variety

Previous research has used the terms novelty and variety interchangeably, providing no clear-cut definition. More specifically, past literature has treated novelty as something that is absolutely new (i.e. never been seen or experienced before) or as something that is familiar, yet in different combinations (e.g., Berlyne, 1951, 1971; Hutt, 1970). Furthermore, a stimulus can be novel in relation to what has immediately preceded it, and it could also be subjectively perceived

as new (see Berlyne, 1951; Nunnally & Lemond, 1973). This creates problems in disentangling the effects of novelty and variety. Furthermore, many studies have measured novelty and variety in conjunction with other constructs such as arousal or excitement (i.e., Aron et al., 2000), which create further problems in unraveling the sole effects of novelty and variety.

To provide a more precise, yet inclusive definition of novelty and variety in the present study, we combined the two constructs and conceptualize them to be the individual perception of experiencing or doing something new, including switching things up in different combinations. It can be something completely new (such as rock climbing if one has never done so before) or something familiar (such as playing basketball again after a prolonged hiatus). However, the activity or the experience cannot be perceived as overly repetitive or routine. In this, novelty and variety are understood as varying degrees of the same construct and thus will be treated interchangeably. This is what we call *novelty-variety*. This definition is justified through its use in previous research (see the review below), as well as our findings in the pilot study (discussed later in this paper).

2 Chapter: Theoretical Basis for the Importance of Novelty-Variety

2.1 Evolutionary Theory

There is reason to believe that a need for novelty-variety has evolved in humans and is important for survival. The exploration of new resources and a wider variety of resources have been suggested to have evolutionary advantages (see Francis & Inzlicht, in press), as individuals with a tendency towards novelty-variety are likely to gain greater knowledge and mastery over their environment. Indeed, previous research links early preference towards novelty-variety to greater learning and intelligence (Houillon et al., 2013; Eaves & Glen, 1996; Sternberg, 1981). This would indeed serve as a great survival advantage.

In addition, the exploration of new resources has been pitted against the exploitation of current resources as two strategies that operate in a delicate balance necessary for survival (Cohen, McClure, & Yu, 2007). Exploitation of resources involves meeting needs through familiar sources, such as acquiring food from a known-source (Cohen et al., 2007). Alternatively, exploration prepares the organism for future rewards by searching for novel sources and reducing uncertainty by gathering information (Cohen et al., 2007; Francis & Inzlicht, in press). As such, exploration allows for the possibility of finding better sources of food (Cohen et al., 2007; Francis & Inzlicht, in press) and potential mates. This would lead to better nutrition through wider variety of foods and more chances for reproduction than immediately available. Therefore, it would be evolutionary advantageous, if not necessary, for humans to have developed mechanisms to disengage from exploiting the same resources when the rewards no longer outweigh the costs of exploring new sources (Kurzban et al., 2013). In support of this idea, dopamine pathways in the brain are often activated when seeking novel stimuli, suggesting built-in reward networks to motivate exploration (i.e., Costa et al., 2014; Düzel et al., 2010).

2.2 Personal-Expansion Theory

Personal-Expansion Theory can also be used to explain the importance of novelty-variety. One of the underlying themes of Personal-Expansion Theory is that individuals have a drive to self expand (Gordon & Luo, 2011). In this, novelty-variety is understood to be a central ingredient for satisfying this drive and leading to personal and relational growth. According to Personal-Expansion Theory, individuals increase their resources by engaging in activities that enable them to meet future goals. This is done through novel experiences (i.e. new and different activities) and augmentation (by gaining greater expertise in what is already familiar). Here, novelty-variety is fundamental to increasing resources that are material, social, and expand one's

knowledge and skills (Gordon & Luo, 2011). Furthermore, Personal-Expansion Theory proposes that the effects of novelty-variety on expanding oneself can occur without the experience eliciting arousal or excitement. Indeed, research supports novelty-variety as being innately stimulating and rewarding (i.e., Berlyne, 1970; Rolls, Rolls, Rowe, & Sweeney, 1981; see Ebstein et al., 1996 on dopamine activity). More specifically, research shows that the motivational tendencies towards novelty-variety often remain regardless of arousal or excitement (i.e., Bench, 2014; Gordon & Luo, 2011; Buchanan & Bardi, 2010). In other words, although arousal and excitement are frequently inherent in novel experiences, they are not necessary for the personal or relational growth that results from novel experiences; what is key is the novel nature of the experience.

3 Chapter: Empirical Research on the Importance of Novelty-Variety

3.1 Criteria for basic psychological needs

To further explore novelty-variety as a potential basic need, we used criteria proposed by Baumeister and Leary (1995) to empirically and systematically evaluate novelty-variety within this framework. These stringent criteria have been previously used to evaluate the need to belong, and are necessary for qualifying a motive as a fundamental need (see Baumeister & Leary, 1995). In this section, we will elaborate on each criteria and describe research demonstrating how they have been met (or, in some instances, where more evidence is needed). According to the set criteria, a need should:

> (i) produce effects readily under all but adverse conditions; (ii) have affective consequences; (iii) direct cognitive processing; (iv) lead to ill effects (such as on adjustment or health) when thwarted; (v) elicit goal-oriented behaviour designed to satisfy it; (vi) be universal in the sense of applying to all people; (vii) not be

> derivative of other motives; (viii) effect a broad variety of behaviours; and (ix) have implications that go beyond immediate psychological functioning. (Baumeister and Leary, 1995).

3.1.1.1 Novelty-variety in various settings, behaviours, and outcomes

The first and the eighth criteria suggests that a need should operate in most normal circumstances (that is, across a wide variety of settings), and impact a wide variety of behaviours. In support of these two criteria, previous research suggests that novelty-variety has implications for many positive outcomes in a variety of different settings. In studies where participants are instructed to perform novel activities in their daily lives, they often report experiencing higher satisfaction and well-being (Buchanan & Bardi, 2010; Sheldon et al., 2012; Lyubomirsky, et al., 2005). For example, in a correlational study consisting of 1035 participants who completed two weekly sessions of a mandatory Physical Education class, higher overall novelty was related to higher life satisfaction (González-Cutre et al., 2016). In addition, they also found higher novelty in physical education to be related to greater intrinsic motivation. In romantic relationships, the experience of novelty-variety has been illustrated to help couples self-expand and increase their relationship satisfaction and relationship quality (Aron et al., 2000; Reissman, Aron, & Bergen, 1993). Self-expansion can occur when romantic partners engage in novel experiences that are challenging and/or interesting (Aron et al., 2000; Reissman, Aron, & Bergen, 1993). For example, in an experimental study, married couples who engaged in self-expanding activities together for ten weeks reported greater marital satisfaction than couples who engaged in pleasant but non-expanding activities (Reissman et al., 1993). This finding was replicated by Aron and colleagues (2000) who used a newspaper questionnaire, a door-to-door survey, and three laboratory experiments to assess the effects of the couples' participation in

novel and arousing activities on relationship quality. More specifically, they engaged couples in either a 7-minute novel and arousing activity, or a more mundane activity. They found many benefits for the participants in the novel and arousing condition compared to the other condition. This included reduced relational hostility and negative affect, and increased support and acceptance within the relationship.

Novelty-variety has also been shown to influence a wide variety of other behaviours such as exercise adherence and performance (Sylvester et al., 2016b; Juvancic-Heltzel et al., 2013), consumer choices (i.e., Wood, 2004), and improving reading performance of children with learning disabilities (Beike & Zentall, 2012), amongst many others. For example, in the context of exercise, Sylvester and colleagues (2016b) ran a 6-week exercise program with inactive university students randomly assigned to a high or a low variety support condition. They found that those in the high variety support group were more likely to stick to their exercise regiment compared to the low variety support condition. The influence of novelty-variety is also evident in everyday personal choices and consumer behaviour. Research has found that individuals often sacrifice real-time enjoyment in exchange for experiencing novelty-variety. For example, in a series of three experimental studies by Ratner and colleagues (1999), participants listened to songs from a list and then ranked them. Subsequently, participants chose the song(s) that they would listen to for the remainder of the experiment. Interestingly, participants switched away from listening to their favourite song in the mix, despite reporting that listening to the other songs was less pleasant. These results are similar to those found for consumer behaviour showing that participants tend to choose numerous different snacks for their future consumption, as opposed to choosing only their most favourite (Read & Loewenstein 1995; Simonson, 1990). Together, these findings from different areas of research and from multiple domains support

Baumeister and Leary's (1995) criteria 1 and 8, that novelty-variety produces effects readily across a broad range of settings and behaviours.

3.1.1.2 Novelty-variety, emotion, cognition, and motivation

The second and third criteria refer to the emotional and cognitive patterns that the need activates, which determine subjective importance (Baumeister & Leary, 1995). The idea is that internal motivational systems direct behaviour towards desired states, and away from undesired states.

Emotion. Research suggests that novelty-variety can predict the experience of positive emotions in many different areas of life, including in everyday activities, in relationships, and at school (i.e., Sheldon et al., 2013; Aron et al, 2000; Daschmann et al., 2011). Alternatively, research also suggests that in the absence of novelty-variety, these positive effects depreciate and can, for example, lead to feelings of low pleasure, constraint, and unpleasantness (i.e., Smith, 1981; Geiwitz, 1966). A recent study suggests that novelty-variety is especially important for combating hedonistic adaptation (Sheldon et al., 2012). Hedonistic adaptation includes the depreciation of positive emotions over a relatively short period of time, making it difficult to maintain well-being beyond situational circumstances. There is growing evidence that novelty-variety helps combat this adaptation response, and is important for long-term maintenance of positive emotions (see Sheldon et al., 2012).

Cognition and Motivation. Research has also found novel stimuli to have a notable effect on the brain by influencing attention, memory and intelligence (i.e., Berlyne, 1974; Eaves & Glen, 1996; Friedman, 1979; Fagan & Detterman, 1992). In a review, Nunnally and Lemond (1973) found that in 29 of 33 experiments, novel stimuli dominated visual investigation.

Moreover, reward networks in the brain have been linked to the release of dopamine that encourage the exploration of new stimuli (see Costa et al., 2014; Düzel et al., 2010). Furthermore, these reward networks rapidly produce less and less rewards with frequent exposure, as the stimulus becomes more familiar (Berlyne, 1974). This suggests a mechanism in the brain that drives attention and behaviour towards novel stimuli, and away from repetition. A recent study found participants to choose novel pictures when bored, even when the novel pictures were negative in nature (Bench, 2014). This provides further support for internal motivational tendencies towards novelty-variety, even at the cost of experiencing negative emotions.

3.1.1.3 Boredom studies and ill-effects

The fourth criteria suggests that failure to satisfy a fundamental need should produce ill effects that go beyond temporary affective distress. Although we only found one study that explicitly thwarted novelty-variety (Sheldon, Boehm, Lyubomirsky**,** 2012), we also use related studies that focus on routine activities to provide a proxy for the absence of novelty-variety and demonstrate the effects of such an absence on various important outcomes. For example, novelty-variety has been shown to have negative effects on well-being. In a longitudinal experimental study by Sheldon, Boehm, and Lyubomirsky (2012), they found students assigned to a low variety condition to experience diminished happiness during a follow-up assessment, while students in the high variety condition reported enhanced happiness following the intervention. Furthermore, research has linked engaging in overly routine tasks to boredom, decreased well-being, and lower satisfaction (Daschmann et al., 2011; Tze, Daniels & Klassen, 2016; Smith, 1981). Boredom from perceived repetitiveness has also been shown to impede learning and engagement (see a meta-analysis on academic boredom: Tze, Daniels & Klassen,

2016). Boredom is even predictive of risky behaviours (such as substance use), delinquency, and aggression (Dahlen, Martin, Ragan, & Kuhlman, 2004; Iso-Ahola & Crowley, 1991; Sharp et al., 2011). In a longitudinal study, Sharp and Colleagues (2011) found adolescents' substance use to increase with leisure boredom. They also found new leisure activities to help decrease some forms of substance use (in particular, the use of marijuana). This may mean that some people cope with a lack of novelty-variety by engaging in maladaptive behaviours such substance use (Iso-Ahola & Crowley, 1991). These studies suggest that the absence of novelty-variety may have important negative consequences. However, more research that directly thwarts novelty-variety is needed to more firmly establish these effects.

3.1.1.4 Universality of novelty-variety

The sixth criterion demands the universal application of a need. Universality includes transcending age, gender, and cultural boundaries. Many of the noted outcomes covered in this paper hold across the life-span. For example, the effects of novelty-variety on attention, development, and memory remain throughout the lifespan, affecting both children and adults (Eaves & Glen, 1996; Wentworth & Witryol, 2003). For example, studies have consistently shown that children and adults look longer at novel stimuli than more familiar ones (Faw, 1970; Faw & Nunnally, 1968a, Nunnally, 1981). In an experiment by Görlitz (1987), toy wire cages with stuffed toys were placed in several public places in Berlin, East Germany. The author found that younger and older adults inspected the cages in a similar manner as children – all behaved with curiosity and exploratory behaviour regardless of age, questioning, touching and watching the novel situation.

Furthermore, there seems to be no gender differences in relation to the effects of novelty-variety on various outcomes such as relational boredom, everyday happiness, and life satisfaction

(e.g., Harasymchuck & Fehr**,** 2010; Sheldon et al., 2012; González-Cutre et al., 2016). In a recent study examining novelty as a basic psychological need and its influence on life satisfaction and intrinsic motivation in physical education mentioned earlier, González-Cutre et al. (2016) used participants with a broad age range (18 – 65 yeas old) and analyzed any differences in age and gender. They found no significant differences between the groups. In addition, research conducted in different countries (i.e., Spain, Germany, Canada) suggests that the effects of novelty-variety transcend cultural boundaries (e.g., González-Cutre et al., 2016; Silvia, 2005; Görlitz, 1987; Krebs et al., 2009), although more research is needed on this to examine people living in non-western cultures.

3.1.1.5 Novelty-variety as non-derivative of other motives

The seventh criteria states that basic psychological needs should not be derivative of other motives. This refers to the ability of a need to independently contribute to positive outcomes, and lead to negative effects when unsatisfied. Although research is limited, new evidence supports novelty-variety as having distinct effects on well-being, satisfaction, and intrinsic motivation. In the recent study by Sylvester and colleagues (2014) mentioned earlier, they found participants' perception of novelty and variety to uniquely predict well-being and to be empirically distinct from SDT needs (i.e., from competence, autonomy, and relatedness). Similarly, the study by González-Cutre and colleagues (2016) also found that novelty was related to life satisfaction and intrinsic motivation independent of the other SDT needs. However, more research is needed to confirm and expand these effects in different domains of life and for different outcomes.

3.1.1.6 Novelty and psychological functioning

The ninth criteria suggests that a need must go beyond immediate psychological functioning. In other words, experiences of novelty-variety should enable optimal functioning that transcend short-term gains. In support of this criteria, previous research has found alternating tasks (i.e., novelty-variety) to aid in learning at schools and creativity at work (Wentworth & Witrol, 2003; Schweizer, 2006; Herrmann & Felfe, 2013). For children, social contexts that support novelty seeking behaviours, such as exploration, also enhance their learning and their development (i.e., Wentworth & Witryol, 2003; Claussen, Mundy, Mallik, & Willoughby, 2002). Infants, for example, have a high tendency towards novelty-variety (Cahill-Solis & Witryol, 1994), which is important for exposing them to a many different stimuli which is essential for their developing brains (Eliot, 1999). Novelty preference seems to also be critical for helping adolescents develop their social identities and broaden their capabilities through exploration and risk-taking behaviour (Lightfoot, 1997). However, perhaps the most important implications lie in the link between early preference towards novelty and latter intelligence (Berg & Sternberg, 1985; Fantz, Fagan, & Miranda, 1975). For instance, one early study by Fagan (1984) designed to investigate the link between novelty preference and intelligence, initially tested children at 7 months of age for visual novelty preferences and had their intelligence and visual recognition performance measured at age three and age five. The results showed that novelty preferences had a higher relation to later intelligence measures than did later recognition performance. Similarly, in older adults, greater uses of novelty and complexity in their living environments have been linked to better maintenance and development of cognitive flexibility (Parmelee & Lawton, 1990). Moreover, as mentioned earlier, recent longitudinal studies show the long-term effects of experiencing variety on boosting and maintaining well-being beyond just

situational circumstances (Sheldon, Boehm, and Lyubomirsky, 2012; Sylvester et al., 2016a). Such findings are examples of the importance of novelty-variety as having long-term gains for future outcomes.

4 Chapter: Overview of Current Research

As mentioned earlier, to our knowledge only one previous research study (González-Cutre, 2016) has directly evaluated novelty-variety as a basic psychological need. The aim of the following studies was to further provide evidence towards Baumeister and Leary's (1995) set criteria. More specifically, in a pilot study, novelty-variety questions were devised and measured in four randomly assigned domains to distinguish whether novelty and variety were separate factors and to find the most representative items to capture the construct. As we found evidence for novelty and variety encompassing the same factor, we labeled the construct as *novelty-variety* and explored whether our operationalization was related to well-being outcomes. In study 1, we used the most representative items from the pilot study and examined novelty-variety among other prominent psychological needs from various different models (using 10 candidate needs from Sheldon, Elliot, Kim, and Kasser's 2001 study). In particular, we explored whether novelty-variety was separate from the other well-established needs and if it independently contributed to well-being outcomes. Study 2 explored Baumeister and Leary's fourth criteria. That is, we experimentally manipulated the absence of novelty-variety along with the need for autonomy and relatedness from SDT to observe their impact on well-being. Finally, the 3rd study was aimed to account for the shortcomings of study 2 and to replicate its findings.

4.1 Pilot Study

The aim of the pilot study was largely to operationalize novelty-variety in a basic psychological need framework and to see whether this conceptualization would be linked to well-being and satisfaction in multiple important life domains. More specifically, we devised questions for measuring novelty and variety separately in four different areas of life, namely within the work, relationship, hobby, and friendship domain. We then tested whether the two constructs were distinct in a factor analysis. Finally, we asked participants to rate their level of well-being and satisfaction within the selected domains.

4.1.1 Method

Participants and procedure

On Amazon Mechanical Turk (MTurk), 242 participants were recruited from four Western English speaking countries. MTurk is an online platform than enables users to collect data in exchange for a small monetary compensation. Researchers (e.g. Buhrmester, Kwang and Gosling, 2011) recommend the platform for providing good and efficient source of data. Participants answered a few demographic questions (e.g. age and gender) and were randomly assigned to two of four domains (work/school, hobby, relationship, friendship).[1]

Novelty-variety measure. Novelty-variety items were first devised based on an extensive literature review of novelty and variety to gain a comprehensive understanding of the construct and how it has been used in previous research. Using existing questionnaires on novelty and

[1] Prior to the random assignment of domains, participants first indicated their relationship status as "single", "in a relationship" or "married"; the number of hobbies they engaged in from 0 to 4 (or more); and whether they were currently working, in school, or "none of the above". These questions allowed for more relevant randomization of domains for each participant. If participants were both studying and working, they were instructed to chose the one they typically spend more time during the week.

variety (i.e., Experience Seeking subscale; Zuckerman, 2007), and our understanding of the constructs based on previous research (i.e, Sheldon and Lyubomirsky, 2012), separate questions were developed to measure novelty, variety, and the combination of the two (items that qualify as both novel and different). We aimed to devise questions without other potential confounds (i.e., excitement, opportunity gains, etc.) as we were interested in measuring the unique effects of novelty and variety. For novelty items, a sample question given to participants was "It adds something new to my day, week or month". For variety, a sample question included was "I experience variety in this domain". Questions that could qualify as both novelty or variety included "It takes me out of a normal routine".

After the questions were developed (see full list in appendix A.1), we tailored the items to the domain-specific contexts (work/school, hobby, relationship, friendship) that were presented to participants. For example, for the hobby domain, the question "I have changed things up recently" was tailored to "Within my Hobby Domain, I have changed things up recently". Then participants rated 34 candidate descriptive statements of novelty and variety within the two domains they were randomly assigned. Items were measured on a 7-point Likert scale (1= Strongly Disagree, 7=Strongly Agree) and the questions were randomized to account for order effects. One attention check was placed as a quality check.[2]

Domain well-being and satisfaction. Subsequently, participants rated their level of well-being and satisfaction within the domains, ranging from 1 ("Extremely") to 7 ("Not at all"). More specifically, participants completed the *10-item Positive and Negative Affect Scale* (PANAS; Mackinnon et al., 1999; Watson, Clark, & Tellegen, 1988) and the *Subjective Vitality*

[2] We simply asked participants to choose "Strongly Agree" to ensure they were paying attention when answering the questions.

Scale (SVS; Ryan & Frederick, 1997) in each domain as a measure of well-being. The 10- item PANAS is a brief measure of positive (i.e., joyful, pleased, happy) and negative (i.e., frustrated, depressed, angry/hostile) affect. The *SVS* (Ryan & Frederick, 1997) uses 6 items to assess participants' feelings of subjective vitality in each domain. Sample items on the scale are "I feel alive and vital" and "I don't feel very energetic" (reversed). These two measures have been used in previous research to indicate well-being (Gunnell, et al., 2014; Sheldon & Tan, 2007; Sheldon et al., 2011, Ryan et al., 2010). We also measured *domain satisfaction* directly through the question "how satisfied do you feel in this domain?".[3]

4.1.2 Results

Participants and exclusion criteria. Participants that did not pass the attention checks or took less than 5 minutes to complete the study were excluded from the subsequent analyses.[4] After the exclusion criteria, our sample consisted of 182 participants (52.2% female, M_{age}=38.15, *SD*=12.80, ages ranging from 20 to 74 years old) from the following backgrounds: 84.6% Caucasian, 4.9% Black, 4.9% Hispanic, 8.2% Asian. The number of participants within each domain was as follows: n=121 hobby, n=92 work, n=67 relationship, n=61 friendship, and n=13 in the school domain. Due to the small sample size for the school domain, it was excluded from the analyses.

[3] To measure individual differences, participants also completed the Ten Item Personality Inventory (TIPI; Gosling, Rentfrow, & Swann, 2003). This is a short 10-item scale measuring 5 dimensions of personality (Openness, Conscientiousness, Extraversion, Agreeableness, Neuroticism) on a 7 point Likert scale. Another attention check was randomly placed in the questionnaire for quality control purposes. However, we did not conduct any analyses with this scale.

[4] The exclusion criterion was determined after data collection, but before data analysis. It was based on a test-run in the lab performed by one of the experimenters and 2 research assistants to establish the length of time it would take to complete the study without reading the questions/options. A total of n=60 participants were excluded from the analyses. This included n=40 that did not meet the the 5 minute cut-off criterion and n=20 that failed one or more of the attention checks. All analyses were also run with the excluded participants with similar results.

Factor Analysis of novelty and variety items. In order to assess whether a distinction between the construct of novelty and variety was justified, an Exploratory Principle Component Factor Analysis was conducted on SPSS separately within each domain (work, hobby, relationship, friendship) using the 34 items. Eigenvalues were observed to determine whether novelty and variety would load onto the same (or different) factors. We also assessed the number of factors within each domain to exclude potential confounds. We extracted and analyzed factors with eigenvalues over Kaiser's criterion of 1. Overall, we did not find any distinction between the construct of novelty and variety. In other words, novelty and variety items loaded onto the same factor and appeared to be similarly dispersed among the other factors found within each domain.

More specifically, within the *work* domain, four factors had eigenvalues greater than 1 and in combination explained 73.41% of the variance. We found the first factor to be a combination of novelty and variety items (i.e., I make new choices; I have a variety of options); the second factor to include novelty and variety items in relation to the environment and people (i.e., There are new people in my environment; I get to interact with various people); the third factor to include the experiences and outcomes of novelty and variety (i.e., I do multiple things; unpredictable things happen); and the fourth factor to comprise of negatively worded items of novelty and variety (i.e., Things have become routine; my activities have stayed the same). Overall, we found that novelty and variety items were randomly distributed in each factor and neither one disproportionately loaded onto any one factor. The same pattern of results was observed in the *friendship* domain with 5 factors that had eigenvalues over Kaiser's criterion of 1 and explained 75.17% of the variance. For the *hobby* domain, 7 factors emerged and explained 70.14% of the variance. Again, we found similar loadings to that of the work and friendship

domain (i.e., relationship and negatively worded items loaded onto separate factors). We found the lower factors to only contain one item over r=0.4 (i.e., There are possibilities for new rewards). Finally, in the *relationship* domain, 6 factors emerged and in combination explained 75.65% of the variance. For all domains observed, we did not find novelty and variety items to disproportionately load onto different factors.

Correlation between Novelty and Variety items. To further test whether a distinction between the construct of novelty and variety was justified, we also assessed the correlation between the two. An unusually strong correlation (i.e. above r=.79, Evans, 1996) would justify combining the items into a single factor, while a moderate or low relationship would justify measuring the constructs separately. We found novelty and variety to be highly correlated in all domains measured, ranging from r=.79 to r=.92 (see Appendix B.1). As such, we combined novelty and variety items into a single factor for subsequent analyses.

Final items for novelty-variety. To ensure that the operationalization of novelty-variety was more representative of a single latent variable, we forced all 34 items into 1 factor in a subsequent factor analysis. Items that did not load strongly onto the one factor were excluded. For example, items such as "I'm always interacting with the same people" and "There are new people in my environment" were eliminated as they had relatively low factor loadings and had loaded more closely onto other factors in the previous analyses. We then chose the top three items with the highest factor loadings amongst all of the domains.[5] The final items used in the subsequent analyses were: "I have tried something new recently", "I do something new", and "It adds something new to my day, my week, or my month". These three items were identified as

[5] We chose three items to remain consistent with the number of questions used in the other psychological need measures in our upcoming (study 1).

the most "pure" representations of the novelty-variety construct (i.e., without the convolution of relationship, reward and opportunity).

Well-being and satisfaction. To measure the relationship between novelty-variety and participants' well-being (affect and vitality) and satisfaction, we used the average of the three novelty-variety items and conducted Pearson Correlations for each domain separately. The results are presented in table 1 below.

Table 1. Correlations with novelty-variety, domain affect, vitality, and satisfaction.

Outcome	Hobby	Work	Relationship	Friendship
Domain Affect	.26**	.54***	.47**	.40**
Domain Vitality	.25**	.57***	.54***	.46***
Domain Satisfaction	.16	.54***	.52***	.19

$p < .05$* $p < .01$** $p < .001$***

We found a significant relationship between novelty-variety and affect in all domains measured. More specifically, novelty-variety was related to domain affect in the hobby domain $r = .26$ [.08, .43], $p < .01$; work domain, $r = .54$ [.36, .71], $p < .001$; relationship domain $r = .47$ [.25, .69], $p < .001$; and the friendship domain, $r = .40$ [.16, .37], $p < .01$. We also found a positive and significant relationship between novelty-variety and participant's vitality scores in all domains – in the hobby domain, $r = .25$ [.07, .24], $p < .001$; in the work domain $r = .57$ [.40, .75], $p < .001$, in the relationship domain; $r = .54$ [.33, .75], $p < .001$; and in the friendship domain $r = .46$ [.23, .69], $p < .001$. Finally, we found novelty-variety to have a positive and significant relationship to satisfaction ratings in half of the domains measured. In particular, in

the work domain, $r = .54$ [.36, .71], $p < .001$, and in the relationship domain $r = .52$ [.31, .73], $p < .001$. However, we did not find a relationship within in the hobby domain $r = .16$ [-.02, .34], $p = .07$, or in the friendship domain, $r = .19$ [-.07, .45], $p = .145$.

4.1.3 Discussion

In the pilot study, we did not find support for novelty and variety as distinct constructs, thus we combined the items into a what we labeled as *novelty-variety*. We then used the most representative items to explore the relationship between novelty-variety, well-being (namely affect and vitality ratings) and satisfaction. In line with our expectation, novelty-variety was related to domain affect and vitality for all of the domains measured (work, hobby, relationship, friendship). Novelty-variety was also positively related to domain satisfaction within the work and the relationship domain, but not in the hobby or friendship domain.

4.2 Study 1

The primary aim of study 1 was to provide support for Baumeister and Leary's 7th and 9th criteria suggesting that a basic psychological need should be independent from other needs and go beyond immediate psychological functioning. As such, we tested whether novelty-variety would predict unique variance in well-being outcomes while accounting for the effects of other prominent basic psychological needs. In particular, novelty-variety was first assessed amongst 10 candidate needs (self-esteem, competence, autonomy, relatedness, self-actualization, physical thriving, and security, money-luxury, popularity-influence, and pleasure-stimulation from Sheldon et al., 2001 study) and it was hypothesized that novelty-variety would be independent from the other needs (hypothesis 1). We also hypothesized that novelty-variety would uniquely predict participants' well-being when controlling for the effects of the other 10 needs (hypothesis 2). In addition, we further assessed our two hypotheses within the framework of SDT. More

specifically, we hypothesized that novelty-variety would not be derivative of autonomy, relatedness, or competence. We also expected novelty-variety to be a good fit to the SDT model. In other words, we anticipated that novelty-variety would load onto its own unique factor apart from the SDT needs in factor analysis and for the 4-factor model (with novelty-variety included) to improve the fit of the 3-factor SDT model. We thus used multiple statistical methods to test the addition of novelty-variety to the SDT model. Finally, we again tested our second hypothesis and predicted that when accounting for the contribution of the 3 SDT needs, novelty-variety would uniquely predict well-being.

4.2.1 Method

Participant and procedure

Using MTurk, 301 participants were recruited from four different Western English Speaking countries (Canada, United States, United Kingdom, and Australia). Participants were first instructed to choose three important life domains and to subsequently rate the degree to which novelty-variety and 10 other candidate psychological needs (self-esteem, competence, autonomy, relatedness, self-actualization, physical thriving, and security, money-luxury, popularity-influence, pleasure-stimulation) were satisfied in the three self-selected domains. Each need was assessed using three items on a scale of 1 (not at all) to 7 (very much). The items for the 10 candidate needs were derived from Sheldon et al.'s (2001) study. However, we also added the three novelty-variety questions that we devised in our preliminary study (refer to Appendix A.2 for the full list of the questions). The items were randomly presented to participants and 1 attention check was placed in each domain to ensure participants maintained their attention. Well-being and satisfaction was measured in the same manner as the pilot study.

However, in the present study, we aggregated affect and vitality scores together as a measure of well-being in addition to exploring each component individually.

4.2.2 Results

Exclusion criteria. Participants who did not pass the attention checks, or those who completed the study under 5 minutes, were excluded from the analyses[6]. After the exclusion criteria, we used data from 202 participants in three domains (N=606). Participants were 57.4% female, M_{age}=37.71, *SD*= 12.46, with ages ranging from 19-73 (77.7% Caucasian, 11.9% Black, 4% Hispanic, 6.4% Asian, 2% Aboriginal, 1.5% other).

Correlations between candidate needs. As an initial step to distinguish whether novelty-variety was independent from the 10 candidate needs, we looked at the correlations between the needs. All correlations were computed using Mplus (Muthén & Muthén, 1998–2012) version 7.4 as we had a repeated measures design. More specifically, given that each participant wrote about three different domains, domains were repeated (or nested) within individuals and represent the within-subject level. In this, a multilevel approach was necessary for the nested data structure (2 levels, within and between-subject; Heck & Thomas, 2000). We looked for unusually high intercorrelations between novelty-variety and the other needs to determine whether the ratings of novelty-variety in one domain was related to the ratings of the other needs within the same domain (within-level differences, see Table 3). For example, would participants experiencing high novelty-variety at work also rate experiencing higher autonomy at work? Finding novelty-

[6] The exclusion criteria was based on the initial test-run completed from the preliminary study. The decision for the 5-minute time limit was further justified by the vast majority of participants who also failed the attentions. The n=59 participants excluded from the analyses were comprised of n=41 that did not meet the the 5-minute cut-off criterion and n=18 that failed one or more of the attention checks.

variety to have a relatively high correlation with the other needs would suggest that it may be part of another need, rather than functioning independently.[7]

We found support for our first hypothesis. That is to say, we predominantly found low to moderate correlations between novelty-variety and the other needs, ranging from *r*=.21 to *r*=.57 (see Table 2 for means and SDs, and Table 3 for correlations). However, we noted that novelty-variety and pleasure-stimulation were highly related (r=.73), the highest amongst the 11 needs. A closer look at the items created speculation that pleasure-stimulation may be confounded with novelty-variety. That is, items from pleasure-stimulation "I experience new sensations and activities" and "I find new sources and types of stimulation for myself" appeared to tap directly into the construct of novelty-variety. In addition, pleasure-stimulation also had relatively high correlation with autonomy (*r*=.67) and self-esteem (*r*=.61). We therefore tested the independence of pleasure-stimulation from novelty-variety, autonomy and self-esteem in a Multilevel Confirmatory Factor Analysis (MCFA). In this, MCFA can confirm whether each item adequately fits the recognized latent variable (Brown, 2014).

Overall, we found pleasure-stimulation to be confounded with novelty-variety. In particular, we compared a three factor model (with autonomy and self-esteem as separate latent variables and pleasure-stimulation/novelty-variety as one latent variable) to a four factor model (with all four factors as separate latent variables). The data did not converge on Mplus with the four factor model as pleasure-stimulation and novelty-variety were found to be perfectly

[7] We also observed whether participants' general ratings of novelty-variety (across domains) influenced their general ratings of the other needs (between-level differences). We found moderate to very high correlations between nearly all 11 needs, ranging from *r*=.40 to *r*=.91. This suggests that if a person generally reports one need as highly satisfied, they also rate the others needs as generally highly satisfied as well. We did not find this result particularly meaningful within the context of providing support for, or against, novelty-variety as an independent need. See Table C.1 in the Appendix for the results.

correlated.[8] Alternatively, the three factor model provided good fit[9] and all three pleasure-stimulation items loaded well onto the novelty-variety factor, $X^2_{(8)}= 36.46$, , CFI = .98, RMSEA= 0.77, and a $SRMR_{within}= 0.03$ and $SRMR_{Between}= 0.00$. We also obtained lower AIC and BIC statistics for the three factor model, with AIC= 11888.33, BIC= 11971.97, compared to the four factor model, AIC= 2237.32, BIC= 22556.20.

This suggests that the pleasure-stimulation items represent and fit the latent variable novelty-variety, rather than a separate construct. Therefore, we decided to drop pleasure-stimulation from the model to avoid the problem of multicollinearity.[10]

Table 2. Means and SDs of correlations.

Candidate Needs	*Means*	*SD*
Autonomy	5.36	0.06
Competence	5.40	0.07
Relatedness	5.00	0.08
Self-actualization	5.12	0.08
Physical-thriving	4.48	0.09
Security	5.13	0.07

[8] We received a warning message in the output indicating "…a correlation equal to or above 1…" suggesting that at least one of the constructs was not distinct.

[9] Multiple indicators were used to determine the fit of the model (Raykov & Marcoulides, 2000). We assessed the chi-square goodness-of-fit statistic. A well-fitting model would have a small and non-significant value (Raykov & Marcoulides, 2000). We also used the comparative fit index (CFI), the root mean square error of approximation (RMSEA), and the standardized root mean square residual (SRMR) as guides to assessing the model fit. More specifically, we looked for values of CFI $\geq$ .95 and RMSEA and SRMR $\leq$.05 (Browne & Cudeck, 1993; Hu & Bentler, 1999). In addition, we used the Akaike Information Criterion (AIC) and Bayes Information Criterion (BIC) to compare alternative models. The AIC is a comparative measure of fit used when comparing different models, with a lower AIC being indicative of a better fit. The BIC is an indication of model parsimony (Kline, 2010), with lower values also indicating better model fit.

[10] All analyses were also conducted with pleasure-stimulation included with relatively similar results. See table C.2 in Appendix for analyses with pleasure-stimulation.

Self-esteem	5.54	0.07
Pleasure-stimulation	4.89	0.07
Money-luxury	3.99	0.10
Novelty-variety	5.07	0.07

All values are greater than $p < .001$

Table 3. Within-subject latent factor correlations between Candidate Needs.

Candidate Needs	1	2	3	4	5	6	7	8	9	10	11
1. Autonomy	1.000										
2. Competence	.240	1.000									
3. Relatedness	.481	.095	1.000								
4. Self-Actualization	.673	.285	.629	1.000							
5. Physical-Thriving	.402	.278	.495	.500	1.000						
6. Security	.341	.219	.365	.408	.338	1.000					
7. Self-Esteem	.693	.461	.383	.649	.437	.415	1.000				
8. Pleasure-Stimulation	.670	.280	.447	.616	.521	.252	.606	1.000			
9. Popularity- Influence	.348	.311	.631	.446	.349	.305	.375	.323	1.000		
10. Money-Luxury	.390	.247	.368	.286	.390	.298	.314	.329	.345	1.000	
11. Novelty-variety	.573	.372	.222	.501	.243	.081	.519	.725	.185	.214	1.000

Note. The heading numbers from 1 to 11 correspond to the names in first column

Apart from pleasure-stimulation, which was assessed using items that tapped into novelty-variety, we found preliminary evidence that novelty-variety and the other needs are separate constructs. In other words, the ratings of novelty-variety within the same domain had

little to moderate influence on the ratings of the others needs. This provides initial support for novelty-variety as an independent construct.

11 Candidate needs and well-being. To test our second hypothesis, we examined the unique effects of novelty-variety on well-being outcomes. More specifically, we aggregated affect and vitality scores together as a measure of well-being and ran a multilevel mixed-effects model (akin to a regression) with all 10 needs entered as predictors. This enabled us to test whether novelty-variety added unique variance to well-being while accounting for the affects of the other needs. The results are displayed in Table 4 below.

In line with our hypothesis, we found novelty-variety to independently predict participants' ratings of well-being, *b*= .18, CI[.12, .24]. In fact, novelty-variety was the third highest predictor of well-being amongst the 10 candidate needs.

Table 4. Study 1. Multilevel mixed-effects model with 10 candidate basic psychological needs and well-being.

Candidate Needs	*b*	*t*	*SE*	95% CI
Autonomy	.20***	5.74	.04	.13, .27
Competence	-.07*	-2.01	.03	-.13, -.001
Relatedness	.11***	3.58	.03	.05, .17
Self-actualization	.12***	3.62	.03	.06, .19
Physical thriving	.10***	3.88	.03	.05, .15
Security	.05	1.63	.03	-.01, .11
Self-Esteem	.35***	8.15	.04	.26, .43
Popularity-influence	-.11***	-3.93	.03	-.16, -.05
Money-luxury	.02	.79	.03	-.03, .07

Novelty-variety	.18***	6.13	.03	.12, .24

p < .05* *p* < .01** *p* <.001***

10 candidate needs and satisfaction. The same procedure was repeated to analyze the effects of novelty-variety on participants' satisfaction ratings. However, our hypothesis was not supported. In other words, novelty-variety did not significantly predict participants ratings of satisfaction after accounting for the contribution of the other needs *b*= .11, CI[-.03; .25]. We also found this unexpected result with competence, relatedness, and self-esteem not reaching significance.

Table 5. Multilevel mixed-effects model with 10 candidate basic psychological and satisfaction.

Candidate Needs	*b*	*t*	*SE*	95% CI
Autonomy	.21*	2.46	.09	.04, .38
Competence	.04	.53	.08	-.11, .19
Relatedness	-.03	-.41	.07	-.17, .11
Self Actualization	.23**	2.84	.08	.07, .38
Physical Thriving	.16**	2.58	.06	.04, .28
Security	.26***	3.62	.07	.120, .404
Self-Esteem	-.09	-.88	.10	-.289, .111
Popularity-Influence	-.02	-.28	.07	-.146, .110
Money-Luxury	-.12	-1.92	.06	-.233, .002
Novelty-variety	.11	1.56	.07	-.028, .247

P < .05* *P* < .01** *P* <.001***

Novelty-Variety within the SDT model. To provide evidence towards our first hypothesis within the framework of SDT (that novelty-variety is independent from the other needs), we used Mplus to conduct a Multilevel Exploratory Factor Analysis (MEFA). Again, a multilevel approach was necessary for the nested data structure. In this, MEFA breaks down the total sample covariance matrix into joint within and between-group covariance matrices to analyze the factor structure at each level (Nezlek, 2008). Furthermore, MEFA determines the minimum number of latent variables that can adequately fit the data. Through this method, we tested the SDT model with and without novelty-variety included as a separate factor. We looked at model fit[11], the factor loadings, and the correlations between the needs to determine whether novelty-variety as a separate need would improve the model. We compared models with all combinations of the needs (i.e., using both restricted and unrestricted models for within and between, with one to four combinations separately).[12] The results of each model is presented in Table 6.

Overall, a clear trend was found with a 4 factor model being superior to a 3 factor model. More specifically, a within-subject 4 factor model with the between portion set as unrestricted (4WUB) was found to be the best fit, having the lowest chi-square goodness-of-fit statistic of $X^2_{(24)}= 34.91$, CFI = .99, RMSEA= 0.00, and a $SRMR_{within}= 0.01$ and $SRMR_{Between}= 0.00$. We also obtained lower AIC and BIC statistics for the 4WUB model, with AIC= 23161.23, BIC= 23451.76, compared to the 3W4U factor model, AIC= 23264.09, BIC= 23515.00.

[11] Multiple indicators were used to determine the fit of the model (Raykov & Marcoulides, 2000). We first assessed the chi-square goodness-of-fit statistic. A well-fitting model would have a small and non-significant value (Raykov & Marcoulides, 2000). We also used the comparative fit index (CFI), the root mean square error of approximation (RMSEA), and the standardized root mean square residual (SRMR) as guides to assessing the model fit. More specifically, we looked for values of CFI ≥ .95 and RMSEA and SRMR ≤.05 (Browne & Cudeck, 1993; Hu & Bentler, 1999). In addition, we used the Akaike Information Criterion (AIC) and Bayes Information Criterion (BIC) to compare alternative models. The AIC is a comparative measure of fit used when comparing different models, with a lower AIC being indicative of a better fit. The BIC is an indication of model parsimony (Kline, 2010), with lower values also indicating better model fit.

[12] Five of the models (1W3B, 2W3B, 3W3B, 4W3B, and UW3B) did not converge, which resulted in 20 models for analysis.

Table 6. MEFA Goodness-of-Fit Indicators for all possible combinations.

	AIC	BIC	CFI	RMSEA	SRMR within	SRMR between	Chi sq	df
1W1B	24346.21	24610.33	0.70	0.13	0.140	0.10	1231.89	108
2W1B	23699.65	24012.19	0.88	0.09	0.079	0.11	563.33	97
3W1B	23443.49	23800.04	0.95	0.06	0.058	0.14	287.17	87
4W1B	23298.23	23694.40	0.99	0.03	0.024	0.12	123.91	78
UW1B	23181.95	23340.42	0.98	0.00	0.000	0.1	115.63	54
1W2B	24209.63	24522.17	0.74	0.13	0.138	0.12	1073.32	97
2W2B	23595.15	23956.11	0.91	0.08	0.080	0.09	436.83	86
3W2B	23360.44	23765.41	0.97	0.05	0.036	0.07	182.12	76
4W2B	23269.09	23713.69	0.99	0.01	0.019	0.07	72.77	67
UW2B	23142.59	23349.48	0.99	0.00	0.00	0.06	54.28	43
1W4B	24140.16	24536.34	0.77	0.14	0.14	0.10	965.84	78
2W4B	23601.77	24046.37	0.91	0.09	0.08	0.05	405.45	67
3W4B	23365.80	23854.42	0.98	0.05	0.03	0.04	149.49	57
4W4B	23277.51	23805.74	1.00	0.00	0.01	0.03	43.19	48
1WUB	24155.16	24313.63	0.73	0.11	0.14	0.00	1088.84	54
2WUB	23519.32	23726.21	0.90	0.07	0.08	0.00	431.01	43
3WUB	23264.09	23515.00	0.97	0.03	0.03	0.00	155.77	33
4WUB	23161.23	23451.76	0.99	0.00	0.01	0.00	34.91	24

W= within-level; B=between-level; U=set as unrestricted

Factor loadings and the correlations between the four factors were also observed to assess the independence of novelty-variety from the SDT needs. More specifically, factor loadings were used to ensure that the superior four factor model was comprised of the four needs we expected (i.e., novelty-variety, competence, autonomy and relatedness). The correlations were also used to supplement our findings by showing the relationship between the needs. More specifically, we wanted to ensure that the novelty-variety did not have an unusually high correlation with any of the other needs.

We found all four latent variables to load relatively well into their respective four factor structure with moderate intercorrelations (see Table C.3 in Appendix for factor loadings).[13] This confirms our findings for the model fit, and further provides evidence towards the independence of novelty-variety.

Table 7. MEFA correlations between the 4 needs.

	AUT	COM	REL
AUT	_		
COM	0.10		
REL	0.52*	0.04	
NOVVAR	0.53*	0.36*	0.16*

*p<.05**

[13] We found 2 of the novelty-variety items also loaded onto autonomy, thus we also conducted a separate CFA to test a model with novelty-variety and autonomy as 1 (the same) vs. 2 (separate) factors. As expected, we found support for novelty-variety and autonomy as separate latent variables (see Table C.4 in Appendix).

Well-being within the SDT model. To test our second hypothesis on whether novelty-variety would predict well-being within the SDT framework, we ran a mixed-effects model using SPSS with the four needs entered as predictors. As expected, novelty-variety ratings independently predicted domain well-being, *b*= .23, CI [.17, .29]. However, we did not found novelty-variety to predict domain satisfaction, *b*= .09, CI [-.04, .23]. Interestingly, competence also did not predict domain satisfaction (see table 8). We offer some potential explanations for this finding in the discussion section.

Table 8. Novelty-variety and SDT on well-being and satisfaction.

Psychological Need	Estimate	Sig	*t*	*SE*	95% CI
Well-Being					
Autonomy	.43	<.001	12.71	.34	.36, .49
Competence	.07	.033	2.13	.03	.01, .13
Relatedness	.18	<.001	7.66	.02	.14, .23
Novelty-variety	.23	<.001	7.31	.03	.17, .29
Satisfaction					
Autonomy	.35	<.001	4.80	.07	.21, .49
Competence	.13	.069	1.82	.07	-.01, .26
Relatedness	.13	.016	2.42	.05	.02, .23
Novelty-variety	.09	.176	1.36	.07	-.04, .23

Exploratory Analyses. To explore the influence of novelty-variety on each individual component of well-being, namely affect and vitality ratings within the SDT framework, we

repeated the analyses above with vitality, positive and negative affect entered separately as dependent variables. We found novelty-variety scores to independently predict all individual components of our well-being outcomes. More specifically, novelty-variety predicted positive affect, *b*= .30, CI [.220, .369], negative affect, *b*= -.12, CI [-.195, -.040] and vitality ratings, *b*= .28, CI [.210, .358]. This suggests that novelty-variety is important in all three dimensions of well-being that we measured. The full results are provided in the Appendix (Table C.5).

4.2.3 Discussion

In study 1, we examined the effects of novelty-variety on well-being outcomes amongst 10 candidate psychological needs, and later within the framework of SDT. We employed multiple methods of assessing the independence of novelty-variety, including performing correlations, factor analyses, and multilevel mixed models. As hypothesized, and in all methods used, novelty-variety was found to be independent from other basic needs measured, and to contribute to well-being outcomes above and beyond the effects of the other needs. In fact, novelty-variety was found to be an important predictor of well-being, ranking amongst the top three predictors when pinned against the initial 10 candidate needs. We also found novelty-variety to be a good addition to the SDT model and to predict unique variance in well-being, independent to that of three SDT needs. In this, novelty-variety was found to be a larger predictor of domain well-being than some of the other well-established needs (i.e., relatedness and competence). However, we did not find novelty-variety to significantly predict domain satisfaction. This was a finding that extended to other well-established needs (i.e., competence and and self-esteem).

4.3 Study 2

The aim of study 2 was to to tackle one more of Baumeister and Leary's 9 criteria and to experimentally validate the results from study 1. More specifically, the purpose of the present study was to test whether novelty-variety would lead to adverse effects when thwarted, to confirm our findings from study 1 that novelty-variety was not derivative of the other SDT needs, and that novelty-variety has implications for well-being. We were also interested in comparing the effects of thwarted novelty-variety with the other unsatisfied needs on well-being outcomes. With this intention, we experimentally manipulated the satisfaction of novelty-variety and two other SDT needs (relatedness and autonomy) in work-related vignettes. In four separate conditions, one need was thwarted at a time and the impact on well-being was observed. In particular, we were interested in examining the effects of thwarted novelty-variety in relation to when all four needs were satisfied (novelty-variety, autonomy, relatedness, and competence) to test whether it would lead to a reduction in well-being, and how this reduction would compare to when autonomy or relatedness was thwarted. Specifically, our hypotheses were as follows:

Hypothesis 1. Participants will report lower well-being when novelty-variety is thwarted compared to when all four needs are met. This would indicate that novelty-variety can lead to diminished in well-being when unsatisfied, even when the SDT needs are fulfilled.

Hypothesis 2. Novelty-variety will be independent from the SDT needs. This will establish whether we replicate our results from Study 1.

Hypothesis 3. Novelty-variety will uniquely predict well-being outcomes when accounting for the effects of the other SDT needs. This would again establish whether we replicate our results from Study 1 in relation to the influence of novelty-variety for experiencing well-being.

Hypothesis 4. Thwarted novelty-variety will impact well-being to the same extent as thwarted relatedness and thwarted autonomy. This would provide evidence towards novelty-variety being similarly important as the other SDT needs.

4.3.1 Method

Participants and procedure.

On MTurk, 483 participants were recruited from three different Western speaking countries (Canada, United States, and Australia). Participants first answered a few demographics questions before being randomly assigned to one of four experimental condition. More specifically, participants were asked to imagine themselves within a work scenario in which they were to briefly write about their feelings and thoughts.

In the *first condition*, participants read a description of a hypothetical work-scenario. In this description, the three SDT needs (competence, relatedness, and autonomy) were satisfied, as well as the the need for novelty-variety. Participants read:

> *"Imagine that you have a career that is based on your own personal choice and that interests you. You work with various teams of co-workers in which you have a good relationship with and feel connected to. You do well in your career and are capable at the projects that you work on. A typical day at work involves doing different kinds of work and working on new projects."*

In the second condition, participants similarly read a description about a hypothetical work life that satisfied the three SDT needs. However, in this condition, the need for novelty-variety was thwarted. Participants read the following description:

"Imagine that you have a career that is based on your own personal choice and that interests you. You work with a team of co-workers in which you have a good relationship with and feel connected to. You do well in your career and are capable at the projects that you work on. A typical day at work involves doing routine work that is well-known to you."

In the third condition, the need for novelty-variety, as well as autonomy and competence from SDT were met. However, the need for relatedness was thwarted. Participants read:

"Imagine that you have a career that is based on your own personal choice and that interests you. You work with various teams of co-workers in which you don't have a strong relationship with or feel connected to. You do well in your career and are capable at the projects that you work on. A typical day at work involves doing different kinds of work and working on new projects."

In the fourth condition, the need for novelty-variety, as well as relatedness and competence from SDT were met. However, the need for autonomy was not satisfied. These participants read:

"Imagine that you have a career that is not based on your own personal choice and does not personally interest you. You work with various teams of co-workers in which you have a good relationship with and feel connected to. You do well in your career and are capable at the projects that you work on. A typical day at work involves doing different kinds of work and working on new projects."

After the priming procedure, participants rated the degree to which the four needs (novelty-variety, relatedness, competence, and autonomy) were satisfied in the work-vignettes.

We used the same three items as study 1 to measure each need. Well-being and satisfaction was also assessed in the same way as study 1.[14]

4.3.2 Results

Participants and exclusion criteria. Participants who did not pass the attention checks or completed the study under 5 minutes were excluded from further analyses.[15] After the exclusion criteria, the sample consisted of 399 participants (58.4% female, M_{age}=35.64, *SD*= 12.33) who were mainly Caucasian (81.2% Caucasian, 9% Black, 5.5% Hispanic, 4.3% Asian, 1.9% Other). Within the four conditions, n=94 participants were in condition 1, n=109 in condition 2, n=96 in condition 3, and n=100 in condition 4.

Manipulation Check. We used three One-way ANOVAs with planned contrasts to test whether our manipulations were successful (see table 9). More specifically, we assessed whether the ratings of each thwarted need (novelty-variety, relatedness, and autonomy) was significantly different from when it was satisfied in the other conditions.

We found the manipulations to be successful. More specifically, participants reported experiencing lower novelty-variety in the thwarted novelty-variety condition compared to the other conditions, $t(395)= 6.43$, $p <.001$. Similarly, we found ratings of relatedness to be significantly lower in the thwarted relatedness condition compared to the other conditions,

[14] Participants also rated the level of boredom and challenge/difficulty they perceived in the work-vignettes on a scale of 1 (not challenging at all) to 7 (highly challenging). We did not find any meaningful differences with these items, and as such, we did not report them in the analyses.

[15] A total of 84 participants were excluded. These were n=33 subjects who did not complete the manipulation, n=40 that did not meet the the 5 minute cut-off criterion and n=11 that failed one or more of the attention checks.

$t(395)= 9.82$, $p < .001$. Finally, autonomy ratings were also significantly lower in the thwarted autonomy condition compared to the other conditions $t(395)= 14.68$, $p < .001$.

Table 9. Means, Standard Deviations, and planned contrasts of the manipulation check.

		Condition				Contrast					
Needs		NS	-N	-R	-A	NS	-N	-R	-A	F	Sig
Autonomy	M=	5.94[a]	5.47[b]	5.78[a]	3.82[c]	1	1	1	-3	38.25	<.001
	SD=	0.87	1.05	.95	1.52						
Relatedness	M=	5.79[a]	5.56[a]	4.18[b]	5.10[c]	1	1	-3	1	74.00	<.001
	SD=	0.95	0.93	1.55	1.02						
Novelty-variety	M=	6.03[a]	4.41[b]	5.59[a]	4.53[c]	1	-3	1	1	34.70	<.001
	SD=	0.80	1.64	1.12	1.50						

NS= All needs met (condition1), -N= no novelty-variety (condition 2), -R= no relatedness (condition3), -A= no autonomy (condition 4). Different superscripts within the same row indicate significant differences between the means from the other conditions. The same superscript indicates the means are not significantly different from one another.

In subsequent post-hoc tests, we also examined whether the thwarting (i.e., manipulating) of each need impacted the ratings of other needs.[16] For example, did the rating of novelty-variety differ when relatedness or autonomy was thwarted? If so, this would suggest that novelty-variety may not operate independently. As such, we compared the ratings of each need (i.e., novelty-

[16] We decided to set the alpha level at .05 although we conducted four contrasts for each need, because we were expecting to find significant difference in only 1/4 planned contrasts. In this case, setting the alpha level lower (ex: at .01) would have made it more likely that our findings would not be significant (and in line with our predictions). As such, we used a higher alpha level than suggested for multiple contrasts to account for the inflated probability of supporting our hypothesis.

variety) in the first condition (when all four needs were met) to the ratings of the same need (i.e., novelty-variety) in the other conditions (i.e., when relatedness or autonomy was thwarted). We found the thwarting of all three needs (novelty-variety, relatedness and autonomy) to have some influence on the ratings of the other needs (refer to Appendix D for the analyses[17]). As such, we suggest that this may reflect the inherent interconnectedness of basic needs. Therefore, no conclusions about the independence of novelty-variety, or the other SDT needs, could be made from these analyses.

Thwarted novelty-variety, well-being and satisfaction. To test our first hypothesis (that unsatisfied novelty-variety will lower well-being) and to provide evidence towards our second hypothesis (novelty-variety is independent of the other needs), we again conducted a One-Way ANOVA with three planned contrasts. More specifically, in the first planned contrast we examined whether well-being ratings diminished when novelty-variety was thwarted compared to when all the needs were met (novelty-variety, relatedness, autonomy and competence). In other words, we tested whether the absence of novelty-variety could reduce well-being, even when all three SDT needs were satisfied. This would simultaneously test the independence of novelty-variety from the other needs for experiencing well-being.

To test our fourth hypothesis, the second and third planned contrast assessed the difference between thwarted novelty-variety and the two SDT needs (thwarted relatedness and thwarted autonomy) on participants well-being and satisfaction ratings.[18] In particular, we expected the reduction of well-being for thwarted novelty-variety to be no different than for

[17] See Table D.1, D.2, and D.3 in Appendix for post hoc tests and Table D.4 for the correlations between the needs.

[18] We decided to set the alpha level again at .05 because we were expecting to find significant difference in only 1/3 of the planned contrasts. Setting the alpha level lower would have made it more likely that our findings would be in line with our predictions. As such, we used a higher alpha level than suggested for multiple planned contrasts to account for the inflated probability of supporting our hypothesis if we were to use a lower alpha level.

thwarted relatedness and thwarted autonomy. This would suggest that novelty-variety is not different than the other two well-established SDT needs.

Table 10. Means and Standard Deviations of each need for well-being and satisfaction.

	Well-being		Satisfaction	
Condition	Mean	SD	Mean	SD
NS	6.09[a]	.72	6.09[a]	1.10
-N	5.67[b]	.98	5.50[b]	1.37
-R	5.38[c]	1.13	5.30[b]	1.39
-A	4.04[d]	1.18	3.60[c]	1.37

NS: All needs met; -N: Thwarted novelty-variety; -R: Thwarted relatedness; -A: Thwarted autonomy
Different superscripts within the same column indicate significant differences between the means from the other conditions. The same superscript indicates the means are not significantly different from one another.

As predicted, we found a significant effect of condition on levels of well-being, $F(3, 393)= 74.29$, $p <.001$. All means are illustrated in table 10. In the first planned contrast, we found support for our first hypothesis. More specifically, we found a significant decrease in well-being when novelty-variety was thwarted compared to when all four needs were met, $t(393)= 2.92$, $p=.004$. We also conducted the same analyses for satisfaction ratings and again found a significant effect of condition, $F(3, 393)= 64.68$, $p <.001$, and a decrease in satisfaction ratings when novelty-variety was thwarted compared to when all four needs met, $t(393)= 3.13$, $p =.002$. This suggests that not fulfilling the need for novelty-variety can alone lower well-being and satisfaction, even when all three SDT needs are met.

We could not draw any conclusions from our analyses from the second and third planned contrasts. This was because in subsequent post hoc tests to explore the relationship between all the needs (novelty-variety, relatedness and autonomy) our initial assumption was violated. Even

though we assumed that no significant differences would exist between the SDT needs (i.e., between autonomy and relatedness), however we did not find evidence for this. More specifically, we used Fisher's Least Significant Differences (LSD) to test a total of 6 contrasts to examine the difference between all the conditions[19]. We found thwarted relatedness and thwarted autonomy to lead to a significantly larger reduction in well-being compared to when novelty-variety was thwarted, $t(393)= 2.04$, $p =.042$ and $t(393)=11.55$, $p <.001$, respectively. Furthermore, we also found significantly lower satisfaction ratings when autonomy was thwarted compared to when novelty-variety was thwarted, $t(393)=10.45$, $p<.001$. However, we did not find a significant difference in satisfaction ratings between thwarted novelty-variety and thwarted relatedness, $t(393) = 1.10$, $p =.27$. Interestingly, we also found thwarted autonomy and thwarted relatedness to be significantly different from each other, with thwarted relatedness ($M =5.38$, $SD =1.13$) having higher mean scores for well-being compared to thwarted autonomy ($M =4.04$, $SD =1.18$), $p <.001$, as well as thwarted autonomy having significantly lower satisfaction scores ($M =3.60$, $SD =1.37$) compared to thwarted relatedness ($M= 5.30$, $SD= 1.39$), $p <.001$. The full results of the post hoc test can be found in Appendix D.[20] Thus, our assumption that the autonomy and related needs would contribute similarly to well-being and satisfaction was violated. In other words, given that the two SDT needs predicted well-being to different degrees, we could not conclude whether novelty-variety is similar or different from the two SDT needs.

[19] We again chose a post hoc test that would not be stringent in supporting a null hypothesis, as we expected non-significant results. Using a more stringent test such as Tukey or Bonferroni would have been advantages for finding support for our hypotheses.

[20] See Table D.5 and D.6.

Table 11. Contrast Coefficients.

	Condition			
Contrast	NS	-N	-R	-A
1	1	-1	0	0
2	0	1	-1	0
3	0	1	0	-1

NS= All needs met -N=Thwarted novelty-variety
-R= Thwarted relatedness -A=Thwarted autonomy

Table 12. Planned Contrasts with well-being and satisfaction.

	Contrast	Value	SE	*t*	Sig
Well-being	1	.42**	.14	2.92	.004**
	2	.29*	.14	2.04	.042*
	3	1.63***	.14	11.55	.000***
Satisfaction	1	.58**	.19	3.13	.002**
	2	.20	.18	1.10	.272
	3	1.91 ***	.18	10.45	.000***

*p < .05** p < .01** p<.001****
Contrast 1: NS vs. -N Contrast 2: -N vs. -R Contrast 3: -N vs. -A. NS= All needs met -N=Thwarted novelty-variety; -R= Thwarted relatedness -A=Thwarted autonomy

Further evidence towards novelty-variety. We used multiple regression to confirm our findings from study 1 that novelty-variety is independent from the other needs (hypothesis 2), that it uniquely predicts wellbeing (hypothesis 3), and to also explore the importance of novelty-variety in relation to the other SDT needs. More specifically, Multiple Regression tests the overall effects of all four needs at the same time, regardless of condition. It also allows for the

observation of the relative importance of each need for well-being. In other words, finding that novelty-variety predicts well-being after accounting for the other needs would provide evidence for the independence of novelty-variety, as well as point to its importance for experiencing well-being in comparison to the other needs.

In line with our hypotheses, we found novelty-variety to uniquely predict well-being after accounting for the contribution of the other needs, b =.12, p= 0.002.[21] The four needs together explained 48% of the variance in participants' well-being, $F(4,392)= 89.76$, $p<.001$, with R^2 of .48. In this, novelty-variety was a more important predictor of well-being than the need for competence, which was not found to be significant (b =.07, p =.32). However, we only found tentative evidence for novelty-variety's importance for predicting satisfaction. Only autonomy (b =.60, p <.001) and relatedness (b =.13, p =0.02) predicted unique variance in satisfaction, while novelty-variety was marginally significant, b =.11, p =0.052, and competence was once again not significant, b =-.07, p =.47). The four needs together explained 37% of the variance in satisfaction, $F(4,392)= 57.31$, p <.001, with R^2 of .37. The full results of each need for participants well-being and satisfaction is displayed in Table 13.

Overall, these results confirm our findings from study 1 that novelty-variety is separate from the other SDT needs and predicts unique variance in well-being. We also found evidence towards the importance of novelty-variety for predicting well-being when compared to the impact of the other SDT needs.

[21] We also conducted further exploratory analyses on the individual components of well-being. We found novelty-variety to predict positive affect and vitality, but not negative affect; see Table C.5 in the Appendix for the analyses.

Table 13. Multiple Regression with well-being and satisfaction.

	Well-being				Satisfaction			
Needs	*b*	*SE*	Sig	CI	*b*	*SE*	Sig	CI
(Constant)	1.12	.31	<.001	.51, 1.72	1.12	.43	.009	.28, 1.96
autonomy	.45	.04	<.001	.37, .54	.60	.06	<.001	.49, .72
competence	.07	.07	.319	-.06, .20	-.07	.09	.470	-.25, .11
relatedness	.15	.04	<.001	.08, .23	.13	.05	.015	.03, .23
novelty-variety	.12	.04	.002	.05,.20	.11	.06	.052	-.001,.22

4.3.3 Discussion

The purpose of the second study was to explore the negative effects of thwarting novelty-variety for well-being and satisfaction and to confirm our results in study 1 (i.e., the independence of novelty-variety from the three SDT basic needs and its contribution to well-being). In work-related vignettes, we found well-being to decline when novelty-variety was thwarted, even when the need for autonomy, relatedness and competence were satisfied. This suggests that well-being can diminish with the absence of novelty-variety, regardless of meeting the other well-established needs. In respect to satisfaction ratings, we found partial evidence towards the importance of novelty-variety. More specifically, we found thwarted novelty-variety to lower satisfaction in one set of our analyses, but to only be marginally significant in the second set. In the present study, we also confirmed our results from study 1, that novelty-variety is not derivative of other motives and it uniquely contributes to well-being outcomes. Furthermore, we found all needs (novelty-variety, relatedness, and autonomy) to contribute differently to well-being and satisfaction ratings within the work vignettes. In this, we could not

draw any conclusions about whether novelty-variety was different, or similar, to the other needs. However, we did find that novelty-variety was important in predicting well-being in relation to the other SDT needs. In particular, novelty-variety was a more important predictor or well-being than the need for competence.

Nevertheless, study 2 had two important limitations. First, we did not randomly present the order of the needs within the manipulations. In other words, the need for autonomy was always the first to be presented, followed by the need for competence, relatedness and novelty-variety. This could influence the salience of each need and impact participants ratings. Therefore, to better establish the effects of each need, it was necessary to replicate the study and present the needs in random order. A second weakness that applied to both study 1 and study 2, was that we exclusively recruited MTurk users. To begin to establish replicability in other samples, it was important to reproduce the effects within a different population. In study 3, we addressed both of these concerns.

4.4 Study 3

Study 3 followed the same procedure as study 2, with the following exceptions: 1) the order of the needs presented to participants within the work vignettes were randomized, and 2) participants were recruited from Carleton University's participant pool on SONA.[22] Similar to study 2, we expected participants in the thwarted novelty-variety condition to report lower well-being compared to participants that had all four needs met (novelty-variety, autonomy,

[22]Two other scales were also added for possible exploratory analyses. 1) *Personal Expansion Scale-The Novelty Subscale* was added. This sub-scale is comprised of 5 questions that measures individual differences towards novelty. It includes questions like "I am always interested in finding new things to try", and "trying new things is important to me to stay happy. 2) *General Psychological Need Scale* and *General Motivation Scale* was also added for possible exploratory analyses.

relatedness, and competence). In addition, we reexamined our hypothesis that participants in the thwarted novelty-variety condition had well-being scores comparable to that of thwarted autonomy and thwarted relatedness. We chose to retest this hypothesis given the possibility of order effects potentially influencing the strength of each need. Finally, we expected novelty-variety to independently predict well-being and satisfaction ratings, separate to that accounted by the SDT needs.

4.4.1 Method

Participants and procedure. The sample consisted of 414 first year Psychology students from Carleton University (74.4% female) with ages ranging between 17 and 50 (M_{age}= 20.44, *SD*= 4.98). [23] Participants came from diverse backgrounds (65.2% Caucasian, 12.1% Asian, 9.2% Middle Eastern, 5.8% Black, 3.4% Hispanic, 1.9% Aboriginal, and 6% Other).

4.4.2 Results

Manipulation check. Similar to the previous manipulation check in study 2, we used three One-way ANOVAs to check our manipulations. We found the manipulation of all three needs to be successful (refer to Table 14). More specifically, novelty-variety ratings were significantly lower in the thwarted novelty-variety condition compared to the other conditions, $t(410)= 5.84$, $p < .001$; relatedness ratings were significantly lower in the thwarted relatedness condition compared to the other conditions, $t(410) = 7.00$, $p < .001$; and autonomy ratings were significantly lower in the thwarted autonomy condition compared to the other conditions $t(410)= 6.52$, $p < .001$.

[23] We used the same exclusion criteria as study 2. A total of 94 participants were excluded from further analyses. This included n=49 subjects who did not complete the manipulation, n=33 did not meet the the 5 minute cut-off criterion, and n=12 that failed one or more of the attention checks.

Table 14. Means, Standard Deviations, and planned contrasts of the manipulation check.

		Condition				Contrast					
Needs		NS	-N	-R	-A	NS	-N	-R	-A	F	Sig
Autonomy	M=	5.60[a]	5.52[a]	5.57[a]	4.71[b]	1	1	1	-3	14.25	<.001
	SD=	.97	1.13	.862	1.53						
Relatedness	M=	5.61[a]	5.6[a]	4.65[b]	5.58[a]	1	1	-3	1	16.37	<.001
	SD=	1.04	.99	1.66	.89						
Novelty-variety	M=	5.64[a]	4.64[b]	5.40[a]	5.27[a]	1	-3	1	1	13.10	<.001
	SD=	1.01	1.55	1.03	1.18						

NS= All needs met (condition1), -N= no novelty-variety (condition 2), -R= no relatedness (condition3), -A= no autonomy (condition 4). Different superscripts within the same row indicate significant differences between the means from the other conditions. The same superscript indicates the means are not significantly different from one another.

Independence of novelty-variety. We decided to use post-hoc comparisons using Bonferroni adjustments to test the independence of the needs within the manipulations. This would be a more rigorous test than planned contrasts for whether the thwarting of one need impacts the other needs (i.e., whether manipulating novelty-variety results in the subsequent lowering of autonomy or relatedness, or vice versa).[24] Through post-hoc comparisons, we aimed to retest our hypothesis in study 2 for the independence of the needs without the potential confound of order effects.

[24] We decided to adjust the alpha level because we were expecting most of the contrasts to be significantly different given our previous results. Not adjusting the alpha level would make it more likely to find a significant effect.

Contrary to our previous findings in study 2, and in support of our hypothesis, the manipulations (thwarting of the needs) did not influence the ratings of the other needs within the same condition. The full results can be found in the Appendix.[25] For example, we did not find the thwarting of novelty-variety to influence ratings of autonomy (M=5.52 in condition 1 when all needs were met, and M=5.60 in condition 2 when novelty-variety was thwarted, p >.5), or the ratings of relatedness (M=5.60 in condition 1 when all needs were met, and M=5.61 in condition 2 when novelty-variety was thwarted p >.5). This suggests that thwarting novelty-variety did not influence participants ratings of autonomy or relatedness and thus is independent from the two SDT needs. The ratings of autonomy and relatedness were also independent of each other. In other words, we found evidence towards the three needs as independent from one another. Potential explanations for the contradictory findings from the previous study are offered in the discussion section.

Thwarted novelty-variety, well-being and satisfaction. To retest our first and second hypothesis from study 2, we again conducted a One-Way ANOVA with post-hoc tests.[26] More specifically, we again tested whether the absence of novelty-variety would reduce well-being, even when all three SDT needs were satisfied. This would simultaneously test the independence of novelty-variety from the other needs for experiencing well-being. We also retested our fourth hypothesis that there would be no differences between well-being and satisfaction ratings between thwarted novelty-variety and thwarted relatedness and thwarted autonomy after accounted for order effects in the present study.

[25] Table E.1, E.2 and E3

[26] We decided to set the alpha level at .05 although we conducted post hoc tests, because we were expecting to not find significant differences for the majority of the planned contrasts.

Table 15. Means and Standard Deviations of Well-being and Satisfaction scores for each condition.

	Well-being		Satisfaction	
Condition	Mean	SD	Mean	SD
NS	5.61[a]	.91	5.49[a]	1.50
-N	5.30[b]	.98	5.03[b]	1.40
-R	4.68[c]	1.00	4.67[b,c]	1.23
-A	4.69[c]	1.20	4.47[c]	1.47

NS= All needs met (condition1), -N= no novelty-variety (condition 2), -R= no relatedness (condition3), -A= no autonomy (condition 4). Different superscripts within the same column indicate significant differences between the means from the other conditions. The same superscript indicates the means are not significantly different from one another. Two superscripts indicate that the condition was similar to two other conditions.

We replicated our findings in study 2 and found support for our first hypothesis. As predicted, we found a significant effect of condition on levels of well-being, $F(3, 410)= 20.95$, $p <.001$ and satisfaction, $F(3, 410)= 10.19$, $p <.001$. All means are illustrated in table 15. More specifically, we found a significant decrease in well-being when novelty-variety was thwarted compared to when all four needs were met, $t(410)= 2.92$, $p =.004$. In relation to satisfaction ratings, we again found a significant decrease in ratings when novelty-variety was thwarted compared to when all four needs met, $t(393)= 2.33$, $p =.002$. This confirms our previous findings in study 2 that not satisfying the need for novelty-variety lowers well-being and satisfaction, even when all three SDT needs are fulfilled.

We found partial support for our fourth hypothesis that thwarted novelty-variety would result in a similar reduction in well-being and satisfaction to that of thwarted relatedness and

autonomy.[27] The post hoc tests for well-being and satisfaction can be found in Table 16 and Table 17 respectively. In particular, we found thwarted relatedness and thwarted autonomy to lead to a significantly larger reduction in well-being compared to when novelty-variety was thwarted, with M_{diff}=.62, SE =.14, p <.001 and M_{diff}= .61, SE =.14, p <.001, respectively. This suggests that when the needs for relatedness or autonomy are unsatisfied, it has a larger impact on well-being compared to when the need for novelty-variety is not fulfilled. We also found significantly lower satisfaction ratings when autonomy was thwarted compared to when novelty-variety was thwarted, M_{diff}=.56, SE =.20, p =.005. In other words, autonomy had a larger impact in reducing satisfaction ratings when it was not satisfied in relation to thwarted novelty-variety. However, we did not find a significant difference in satisfaction ratings between thwarted novelty-variety and thwarted relatedness, M_{diff}=.36, SE =.20, p =.068. This suggests that novelty-variety has a similar impact on satisfaction to that of thwarted relatedness. These findings were similar to the findings in study 2 (see Appendix D).[28]

Given these results, we conclude that thwarted novelty-variety only operates similar to thwarted relatedness for determining satisfaction, but not well-being.

Table 16. Post hoc tests for well-being.

Condition (I)	Condition(J)	M_{diff} (I-J)	SE	p
NS	-N	0.31	0.14	0.029
	-R	0.93	0.14	<.001

[27] We again first tested our initial assumption and did not find a significant difference between thwarted autonomy and thwarted relatedness for well-being M_{diff}=0.003, SE=.198 p=.984 or satisfaction ratings M_{diff}=0.196, SE=.199 p=.326. Thus, our assumption that the needs would operate similarly in the work domain was confirmed in the present study.

[28] Refer to Table D.5, D.6.

	-A	0.92	0.14	<.001
-N	NS	-0.31	0.14	0.029
	-R	0.62	0.14	<.001
	-A	0.61	0.14	<.001
-R	NS	-0.93	0.14	<.001
	-N	-0.62	0.14	<.001
	-A	-0.00	0.14	0.984
-A	NS	-0.92	0.14	<.001
	-N	-0.61	0.14	<.001
	-R	0.003	0.14	0.984

*The mean difference is significant.

Table 17. Post hoc tests for satisfaction.

Condition (I)	Condition(J)	M_{diff} (I-J)	SE	p
NS	-N	0.46	0.20	0.02
	-R	0.82	0.20	<.001
	-A	1.02	0.20	<.001
-N	NS	-0.46	0.20	0.02
	-R	0.36	0.20	0.068
	-A	0.56	0.20	0.005
-R	NS	-0.82	0.20	<.001
	-N	-0.36	0.20	0.068

	-A	0.20	0.20	0.326
-A	NS	-1.01	0.20	<.001
	-N	-0.56	0.20	0.005
	-R	-0.20	0.20	0.326

*The mean difference is significant.

Further evidence towards novelty-variety. To retest our third hypothesis in respect to the unique effects of novelty-variety on well-being and satisfaction, and to again compare the importance of novelty-variety to that of the SDT needs, we ran the same analyses as the previous study.[29]

In line with our previous findings, we found support for our third hypothesis. More specifically, we found novelty-variety to uniquely predict well-being, b =.12, p = 0.004. The four needs together explained 42% of the variance in participants' well-being, $F(4, 409)= 73.74$, p <.001, with R^2 of .42. Moreover, in the present study novelty-variety also predicted satisfaction (b=.12, p= 0.040). The four needs together explained 32% of the variance in satisfaction, $F(4,392)= 57.31$, p<.001, with R^2 of .32. The full results of each need on well-being and satisfaction is displayed in Table 18. These findings confirm our findings in study 2 that novelty-variety predicts unique variance for both well-being, and further suggest that it also impacts participants' satisfaction. We also again found novelty-variety to be a more important predictor or well-being (and also satisfaction in the present study) than the need for competence.

[29] We also conducted the same analyses with each component of well-being (vitality, positive and negative affect) separately. See Appendix D.7 and Table D.8. and D.9.

Table 18. Multiple Regression with needs, well-being and satisfaction.

	Well-being				Satisfaction			
Needs	*b*	*SE*	Sig	CI	*b*	*SE*	Sig	CI
(Constant)	0.85	0.28	.003	0.30, 1.40	-.10	.41	.814	-.90, .71
autonomy	0.35	0.04	<.001	0.27, 0.43	.38	.06	<.001	.26, .50
competence	0.10	0.06	.073	-0.01, 0.21	.14	.08	.075	-.01, .30
relatedness	0.22	0.04	<.001	0.15, 0.30	.29	.05	<.001	.19, .39
novelty-variety	0.12	0.04	.004	0.04, 0.20	.12	.06	.040	.01 ,.24

4.4.3 Discussion

In the present study we accounted for some of the short-comings in study 2 and replicated our findings that the absence of novelty-variety leads to a reduction in well-being, that novelty-variety is independent from the other SDT needs, and that it predicts unique variance in participants' experience of well-being. In addition, we also found novelty-variety to predict unique variance in participant satisfaction ratings. These results provide further evidence for novelty-variety meeting Baumeister and Leary's 4th, 7th and 9th the criteria. We suspect that the lack of randomization of the needs in study 2 may explain why novelty-variety may have resulted in marginal significant effects for satisfaction ratings. In fact, by looking at the ratings of autonomy, it is evident that presenting autonomy first in the work vignettes resulted in higher salience of autonomy when it was thwarted (M_{diff}=2.12) than thwarted novelty-variety (which was presented last, M=1.66). In addition, given that we found the SDT needs to contribute differently to well-being and satisfaction outcomes in study 2, but not in the present study, we suspect that the former outcomes were also to be due to order effects rather than reflecting a real

difference. After correcting for this, we found autonomy and relatedness to reduce well-being and satisfaction to a similar degree. However, we only found partial evidence that novelty-variety was similar to the other SDT needs. More specifically, we found that the effects of thwarted novelty-variety was similar to thwarting relatedness for the experience of satisfaction. However, unfulfilled autonomy and relatedness reduced well-being more than the absence of novelty-variety. Finally, in both study 2 and 3, we found novelty-variety to be a more important predictor of well-being and satisfaction than the need for competence. We suggest that this has important implications for keeping novelty-variety within the SDT framework. Furthermore, this may suggest that novelty-variety may be more important than competence, at least within the work domain.

Chapter 5: General Discussion

In a series of three studies, we provide evidence towards novelty-variety as a basic psychological need by testing a set of stringent criteria proposed by Baumeister and Leary (1995). More specifically, in all three studies we unanimously found evidence towards the independence of novelty-variety from other established needs. In study 1, we demonstrated that novelty-variety predicts well-being, above and beyond the 9 candidate needs that we examined from Sheldon et al.'s 2001 study, including the SDT needs. We utilized various statistical methods, including correlations, factor analyses, ANOVAs, and regressions towards this goal. We also found novelty-variety to be a good fit and to improve the SDT model. More specifically, we found novelty-variety to load onto its own unique factor apart from the need for relatedness, autonomy, and competence in factor analysis, and for the 4-factor model (with one factor tapping into the novelty-variety items) to be a better fit for the data than a 3-factor SDT model. In the second study, we experimentally manipulated the satisfaction of novelty-variety and two SDT

needs in work vignettes and again noted its unique effects on well-being. More specifically, we showed the negative impact of thwarted novelty-variety on well-being and satisfaction (although the impact on satisfaction was marginal in one of the former analyses). In the third study, we replicated our findings that novelty-variety contributed independently to well-being outcomes after accounting for a confound in study 2, and after using a different sample. We found mixed results in respect to the similarity between thwarted novelty-variety and thwarted autonomy and relatedness. More specifically, we found that thwarting the need for autonomy and relatedness resulted in a higher reduction in well-being than thwarting novelty-variety. However, thwarted novelty-variety was not different than thwarting relatedness for satisfaction ratings. Interestingly, we also found novelty-variety to be more important in predicting well-being and satisfaction than the need for competence. Given our findings that thwarted relatedness and thwarted novelty-variety did not differ in lowering satisfaction, as well as finding novelty-variety to have higher predictive abilities than the need for competence for well-being and satisfaction ratings in all three studies, we cannot confidently conclude that novelty-variety is the same or different than to all three SDT needs. In other words, considering that we did not thwart the need for competence, we cannot surely conclude that novelty-variety is similar or different than all three SDT needs. Given our findings, we suspect that thwarting novelty-variety would reduce well-being and satisfaction more than thwarting competence. Future research can further investigate the similarities and differences between novelty-variety and the other needs and explore this possibility. However, we propose that it is important to further consider novelty-variety within the SDT model given our findings.

Considering novelty-variety as a basic psychological need has important theoretical and practical implications, and can provide promising new avenues for research. The evidence

suggesting that novelty-variety is a basic psychological need could lead to a reconceptualization of existing theories of psychological needs. For self-determination theory, which is currently the most commonly used theory of basic needs, this may mean adding a fourth need to the established needs for autonomy, competence and relatedness. That is, if novelty-variety can contribute above and beyond the other needs to outcomes such as well-being and satisfaction, the inclusion of novelty-variety to the theory can potentially offer a more complete understanding of the conditions that lead to optimal functioning in a wide range of contexts. This in turn can spur new research across the many domains where self-determination theory is used, including education, business, health, relationships, mental health, and many others.

Importantly, recognizing novelty-variety as a basic psychological need can lead to the development of interventions designed to optimize experiences of novelty-variety in an effort to increase health, engagement, and well-being. Such interventions are already being tested in sports and physical activities (i.e., Sylvester et al., 2016a, b) and for couples (i.e., Reissman et al., 1993) with promising results. Further research could incorporate interventions to enhance novelty-variety in designing programs to increase well-being and productivity in the professional setting (i.e., in businesses and corporations to increase motivation and retention rates), in education (i.e., to improve classroom learning and satisfaction), and in mental health initiatives (to strengthen personal and relationship well-being). Previous research has found that interventions that provide support for other needs (autonomy, competence, and/or relatedness) can be successful in affecting changes in health behaviours (i.e., increased exercise and healthy eating: Fenner et al., 2013; decreased smoking; Williams et al., 2011) and increasing children's learning (e.g., Guay et al., 2016). Similar interventions could be designed to increase the novelty-variety that is present in these environments, possibly leading to similar effects.

There is no doubt that conceptualizing novelty-variety as a basic psychological need is still in its early stages. There is still much work to be done to develop a valid and encompassing definition and measure of novelty-variety. We acknowledge that our decision to combine novelty and variety, without any distinction of the two, may be questionable. In this, we suspect that novelty and variety may differ in degrees of the same construct, or perhaps may even have distinguishable traits that we were not able to find. We invite future research to investigate the potential theoretical and empirical difference between novelty and variety.

We also used a single item to measure participant satisfaction ratings, which may be questionable. Although using a single item has been deemed acceptable in measuring job satisfaction (Nagy, 2002; and see meta-analysis, Wanous, Reichers, and Hudy, 1997), other researchers note the relative low reliability of one item measures of psychological constructs (Scarpello & Campbell, 1983). As this was not the main focus of the present study, we suggest that our results in this regard be interpreted with caution.

We also acknowledge the potential limitation of using the term “routine” within the work vignettes to capture the absence of novelty-variety. This word is often implicated with boredom and can have a negative connotation. Although we asked participants to rate their levels of boredom following the vignettes to account for this potential confound (and found thwarted autonomy to have higher ratings of boredom), there may be better ways to manipulate the absence of novelty-variety. Future research can investigate alternative ways to thwart novelty-variety to confirm our findings.

More research is also needed to confirm the findings that novelty-variety is independent from the other basic psychological needs. This is a new avenue of research that requires more empirical evidence, especially as there is little experimental and longitudinal studies.

Manipulating novelty-variety alongside other psychological needs would particularly be helpful to analyze the unique effects of novelty-variety in various other important domains and contexts (i.e., relationship, school, and hobby).

We also invite research to look at the possibility and the effects of too much novelty-variety and whether it may thwart other basic needs. We propose that feelings of experiencing "too much" novelty may be due to other needs (i.e., competence) being thwarted simultaneously, which could result in no increases in well-being (the thwarting of competence cancelling the benefits of novelty-variety) or even a decrease in well-being in extreme cases. Empirical research is needed to explore such possibilities.

Future research could also investigate whether thwarting novelty-variety would have negative effects for other outcomes (i.e., for motivation and performance) above and beyond the other needs. To our knowledge, our study is the first to directly looked at the effects of the absence of novelty-variety in relation to other well-established needs. Interestingly, research on other needs has found that the thwarting of these needs first results in efforts to obtain the missing experiences (i.e., need restauration; Radel, Pelletier, Sarazzin & Milyavskaya, 2011; deWall, Maner & Rouby, 2009), with more negative outcomes on well-being and functioning only evident after prolonged need frustration. Measuring both immediate and longer term consequences of thwarting novelty-variety would allow for comparisons to be drawn to the effects of other thwarted needs. If such effects are similar to those of other needs, it would provide more evidence towards novelty-variety as a basic need.

We also believe that more research in different socio-economic and cultural contexts would clarify whether the effects of novelty-variety are universal across diverse populations. Existing research suggests that novelty-variety is important at various stages of the lifespan, for

both men and women, and in a number of different Western countries. However, much more is needed to truly affirm that the need for novelty-variety is universal, including the examination of the role of novelty-variety in non-western countries.

Appendices

Appendix A: Questionnaire Items

A.1. Pilot study novelty and variety Items

Below are the preliminary 34 items devised in the pilot study to measure novelty and variety.

I have changed things up recently

It takes me out of a normal routine

My activities have stayed the same

I have the opportunity to switch things up

It adds something new to my day, week or month

It's predictable

I've been doing new activities

I feel that there are new opportunities

I've been exploring something new

There is nothing new

Things have become routine

I don't have many options on what I can do

I do multiple things

I do more than one thing within a short time-frame

I alternate between tasks

It’s refreshing

Nothing ever changes

I do something new

I make new choices

There are not many choices to choose from

Unpredictable things happen

I have tried something new recently

There are many options on what I can do

There are new people in my environment

There are possibilities for new rewards

I have a variety of options

I experience novelty in this domain

I’m not around new people

I never go to new places

Attention check: please select strongly disagree

I’m not always in the same place(s)

I get to interact with various people

I'm always in the same space

I'm around different kinds of people

I'm always interacting with the same people

I experience variety in this domain

A.2. Study 2 Candidate Needs Items

Below are the items used to measure the 11 Candidate needs in study 1.

1. Autonomy
    a) My choices are based on my true interests and values
    b) I am free to do things my own way
    c) My choices express my "true self"
2. Competence
    a) I successfully complete difficult tasks and projects
    b) I take on and master hard challenges
    c) Very capable in what I do
3. Relatedness
    a) I have a sense of contact with people who care for me, and whom I care for
    b) I have a close and connected with other people who are important to me
    c) I have a strong sense of intimacy with the people I spend time with.
4. Self-Actualization-Meaning
    a) I am becoming who I really am
    b) I have a deeper understanding of myself and my place in the universe
    c) I have a strong sense of intimacy with the people I spend time with
5. Physical Thriving
    a) I get enough exercise and am in excellent physical condition
    b) My body is getting just what it needs

c) I have a strong sense of physical wellbeing

6. Pleasure-Stimulation
    a) I am experiencing new sensations and activities
    b) Intense physical pleasure and enjoyment
    c) I have found new sources and types of stimulation for myself
7. Security
    a) My life is structured and predictable
    b) Glad that I have a comfortable set of routines and habits
    c) Safe from threats and uncertainties
8. Self-Esteem
    a) I have many positive qualities
    b) Quite satisfied with who I am
    c) I have a strong sense of self-respect
9. Popularity-Influence
    a) I am a person whose advice people seek out and follow
    b) I strongly influence others' beliefs and behaviours
    c) I have a strong impact on what other people do
10. Money-Luxury
    a) I am able to buy most things I want
    b) I got plenty of money
    c) I have nice things and positions
11. Novelty-Variety
    a) I do something new

b) It adds something new to my day, my week, my month

c) I have tried something new recently

Appendix B: Pilot Study Analyses

Table B.1.

Correlations between novelty and variety items

Domain	Fvar	Fnov	Hvar	Hnov	Wvar	Wnov	Rvar	Rnov	Fnv3	Hnv3	Wnv3	Rnv3
Fvar	1	.92**	.65**	.59**	0.20	0.11	-0.62	-0.01	.90**	.47**	0.14	-0.01
Fnov	.92**	1	.61**	.55**	0.12	0.05	-0.49	0.05	.96**	.47**	0.05	0.02
Hvar	.65**	.61**	1	.79**	0.19	.30*	0.24	0.11	.57**	.63**	0.27	0.30
Hnov	.59**	.55**	.79**	1	0.21	.35*	0.28	0.07	.48**	.88**	.30*	0.35
Wnov	0.2	0.12	0.19	0.21	1	.85**	0.14	0.06	0.22	0.17	.76**	-0.02
Wvar	0.11	0.05	.30*	.35*	.85**	1	-0.04	0.05	0.11	0.26	.94**	-0.16
Rnov	-0.62	-0.49	0.24	0.28	0.14	-0.04	1	.89**	-0.53	0.21	-0.15	.84**
Rvar	-0.01	0.05	0.11	0.07	0.06	0.05	.90**	1	0.03	0.02	-0.01	.94**
Fnv3	.89**	.96**	.57**	.48**	0.22	0.11	-0.53	0.03	1	.42*	0.12	0.06
Hnv3	.47**	.47**	.63**	.88**	0.17	0.26	0.21	0.02	.42*	1	0.18	0.24
Wnv3	0.14	0.05	0.28	.30*	.76**	.94**	-0.15	-0.01	0.17	0.18	1	-0.23
Rnv3	-0.01	0.02	0.28	0.35	-0.02	-0.16	.84**	.94**	0.06	0.24	-0.23	1

F= Friendship; H= Hobby; W= Work; R= Relationship; var= variety; nov= novelty; nv= novelty-variety
3 = three items; **Correlation is significant at the 0.01 level, * Correlation is significant at the 0.05 level (2-tailed)

Appendix C: Study 1 Analyses

Table C.1.

Between subject latent factor correlations between Candidate Needs.

Need	1	2	3	4	5	6	7	8	9	10	11
Autonomy	1.00										
Competence	.88	1.00									
Relatedness	.80	.83	1.00								
Self-Actualization	.87	.89	.89	1.00							
Physical-Thriving	.67	.64	.67	.75	1.00						
Security	.84	.59	.74	.76	.67	1.00					
Self-Esteem	.84	.82	.90	.89	.61	.76	1.00				
Pleasure-Stimulation	.82	.83	.88	.92	.81	.72	.78	1.00			
Popularity-Influence	.74	.69	.85	.80	.67	.64	.74	.79	1.00		
Money-Luxury	.61	.40	.58	.63	.69	.66	.47	.67	.670	1.00	
Novelty-variety	.78	.88	.91	.91	.68	.58	.81	.94	.87	.54	1.00

Table C.2.

Multilevel Regression: Candidate Basic Psychological Needs (with Pleasure-Stimulation) with Well-being.

Candidate Needs	b	t	SE	95% CI
Autonomy	.173***	4.874	.036	.104, .243
Competence	-.048	-1.504	.032	-.111, .015
Relatedness	.093**	3.177	.029	.036, .151
Self Actualization	.112**	3.422	.033	.048, .177
Physical Thriving	.055*	1.990	.027	.001, .109
Security	.047	1.565	.030	-.012, .105
Self-Esteem	.334***	7.940	.042	.251, .416
Pleasure-Stimulation	.191***	4.620	.041	.110, .272
Popularity-Influence	-.105***	-3.912	.027	-.158, -.052
Money-Luxury	.015	.619	.025	-.033, .064
Novelty-variety	.082*	2.285	.036	.012, .153

$p < .05$* $p < .01$** $p < .001$***

Table C.3.

4-Factor MEFA Loadings.

Items	1	2	3	4
DAUT1	0.769		0.452	0.527
DAUT2	0.639			0.474
DAUT3	0.871		0.454	0.451
DCOM1		0.814		
DCOM2		0.696		0.406
DCOM3		0.514		
DREL1			0.836	
DREL2	0.530		0.867	
DREL3	0.545		0.711	
DNOVVAR1				0.706
DNOVVAR2	0.451			0.835
DNOVVAR3	0.580			0.709

*Values <.40 are not shown.

Table C.4.

Model Fit with novelty-variety and autonomy.

	AIC	BIC	CFI	RMSEA	$SRMR_{within}$	$SRMR_{between}$	Chi sq	df
NV+A	11938.796	12070.854	0.845	0.146	0.089	0.161	247.833	18
NV-A	11819.571	11960.433	0.942	0.094	0.047	0.064	101.864	16

NV+A= novelty-variety and autonomy as 1 factor; NV-A= novelty-variety and autonomy as 2 separate factors

Table C.5.

Novelty-Variety and SDT needs with positive and negative affect and vitality.

Psychological Need	Estimate	Sig	t	SE	95% CI
Positive Affect					
Autonomy	.498	.000	12.153	.041	.417, .578
Competence	.021	.587	.543	.039	-.055, .097
Relatedness	.281	.000	9.631	.029	.223, .338
Novelty-variety	.294	.000	7.733	.038	.220, .369
Negative Affect					
Autonomy	-.375	.000	-8.852	.042	-.458, -.300
Competence	-.049	.227	-1.209	.040	-.128, .030
Relatedness	-.046	.131	-1.513	.030	-.106, .014
Novelty-variety	-.118	.003	-2.983	.039	-.195, -.040
Vitality					
Autonomy	.403	.000	9.900	.483	.323, .483
Competence	.113	.004	2.926	.188	.037, .188
Relatedness	.213	.000	7.348	.270	.156, .270
Novelty-variety	.284	.000	7.509	.358	.210, .358

Appendix D: Study 2 Analyses

Table D.1.

Post Hoc Tests with Autonomy ratings as the dependent variable

(I) condition	(J) condition	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound, Upper Bound	
NS	-N	.48602*	.16174	.003	.1680	.8040
	-R	.17070	.16724	.308	-.1581	.4995
	-A	2.13161*	.16512	.000	1.8070	2.4563
-N	NS	-.48602*	.16174	.003	-.8040	-.1680
	-R	-.31531	.16080	.051	-.6315	.0008
	-A	1.64559*	.15859	.000	1.3338	1.9574
-R	NS	-.17070	.16724	.308	-.4995	.1581
	-N	.31531	.16080	.051	-.0008	.6315
	-A	1.96090*	.16420	.000	1.6381	2.2837
-A	NS	-2.13161*	.16512	.000	-2.4563	-1.8070
	-N	-1.64559*	.15859	.000	-1.9574	-1.3338
	-R	-1.96090*	.16420	.000	-2.2837	-1.6381

NS= All needs met (condition1), -N= no novelty-variety (condition 2), -R= no relatedness (condition3), -A= no autonomy (condition 4). * The mean difference is significant at the 0.05 level.

Table D.2.

Post Hoc Tests with Relatedness ratings as the dependent variable

(I) condition	(J) condition	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound, Upper Bound	
NS	-N	.22149	.16326	.176	-.0995	.5425
	-R	1.57218*	.16881	.000	1.2403	1.9041
	-A	.68106*	.16667	.000	.3534	1.0088
-N	NS	-.22149	.16326	.176	-.5425	.0995
	-R	1.35069*	.16231	.000	1.0316	1.6698
	-A	.45957*	.16008	.004	.1448	.7743
-R	NS	-1.57218*	.16881	.000	-1.9041	-1.2403
	-N	-1.35069*	.16231	.000	-1.6698	-1.0316
	-A	-.89112*	.16574	.000	-1.2170	-.5653
-A	NS	-.68106*	.16667	.000	-1.0088	-.3534
	-N	-.45957*	.16008	.004	-.7743	-.1448
	-R	.89112*	.16574	.000	.5653	1.2170

NS= All needs met (condition1), -N= no novelty-variety (condition 2), -R= no relatedness (condition3), -A= no autonomy (condition 4). * The mean difference is significant at the 0.05 level.

Table D.3.

Post Hoc Tests with novelty-variety ratings as the dependent variable

(I) condition	(J) condition	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower	Upper
NS	-N	1.63623*	.19200	.000	1.2587	2.0137
	-R	.44141*	.19853	.027	.0511	.8317
	-A	1.52564*	.19601	.000	1.1403	1.9110
-N	NS	-1.63623*	.19200	.000	-2.0137	-1.2587
	-R	-1.19482*	.19088	.000	-1.5701	-.8195
	-A	-.11059	.18825	.557	-.4807	.2595
-R	NS	-.44141*	.19853	.027	-.8317	-.0511
	-N	1.19482*	.19088	.000	.8195	1.5701
	-A	1.08423*	.19491	.000	.7010	1.4675
-A	NS	-1.52564*	.19601	.000	-1.9110	-1.1403
	-N	.11059	.18825	.557	-.2595	.4807
	-R	-1.08423*	.19491	.000	-1.4675	-.7010

NS= All needs met (condition1), -N= no novelty-variety (condition 2), -R= no relatedness (condition3), -A= no autonomy (condition 4). * The mean difference is significant at the 0.05 level.

Table D.4.

Correlations between the 4 needs.

Need	1	2	3	4
Autonomy	1.000	.569**	.298**	.550**
Competence		1.000	.310**	.592**
Relatedness			1.000	.241**
Novelty-variety				1.000

p< .05*, *p*< .01**, *p*<.001***

Table D.5.

LSD Post Hoc tests for well-being.

(I) Condition	(J) Condition	*Mean Difference*	*SE*	Sig	95% CI Lower	95% CI Upper
NS	-N	.419*	.144	.004	.136	.702
	-R	.710*	.148	.000	.419	1.001
	-A	2.05*	.147	.000	1.762	2.340
-N	NS	-.419*	.144	.004	-.702	-.136
	-R	.291*	.143	.042	.011	.571
	-A	1.632*	.141	.000	1.354	1.910
-R	NS	-.710*	.148	.000	-1.001	-.419
	-N	-.291*	.143	.042	-.571	-.011
	-A	1.341*	.146	.000	1.055	1.628

-A	NS	-2.051*	.147	.000	-2.340	-1.762
	-N	-1.632*	.141	.000	-1.910	-1.354
	-R	-1.341*	.146	.000	-1.628	-1.055

*The mean difference is significant at the 0.05 level.

Table D.6.

LSD Post Hoc tests for Satisfaction.

(I) Condition	(J) Condition	*Mean Difference*	*SE*	Sig.	95% CI Lower	95% CI Upper
NS	-N	.581*	.186	.002	.22	.95
	-R	.784*	.191	.000	.41	1.16
	-A	2.490*	.190	.000	2.12	2.86
-N	NS	-.581*	.186	.002	-.95	-.22
	-R	.203	.184	.272	-.16	.56
	-A	1.909*	.183	.000	1.55	2.27
-R	NS	-.784*	.191	.000	-1.16	-.41
	-N	-.203	.184	.272	-.56	.16
	-A	1.706*	.189	.000	1.34	2.08
-A	NS	-2.490*	.190	.000	-2.86	-2.12
	-N	-1.909*	.183	.000	-2.27	-1.55
	-R	-1.706*	.189	.000	-2.08	-1.34

NS= All needs met (condition1), -N= no novelty-variety (condition 2), -R= no relatedness (condition3), -A= no autonomy (condition 4). * The mean difference is significant at the 0.05 level.

Table D.7.

Multiple Regression with the Needs and Positive and Negative Affect.

	Positive Affect				Negative Affect			
Needs	*b*	*SE*	Sig	CI	*b*	*SE*	Sig	CI
(Constant)	.706	.360	.050	-.001, 1.413	5.469	.363	.000	4.756 , 6.183
Autonomy	.539	.050	.000	.441, .637	-.314	.050	.000	-.413 , -.215
Competence	-.008	.077	.914	-.160, .143	-.187	.078	.017	-.340 , -.034
Relatedness	.194	.045	.000	.106, .282	-.115	.045	.011	-.204 , -.026
Novelty-variety	.132	.047	.005	.039, .225	.001	.048	.976	-.092 , .095

Table D.8. Multiple Regression with Needs and Vitality.

Needs	*b*	*SE*	Sig	CI
(Constant)	.114	.350	.746	-.575 .802
Autonomy	.508	.049	.000	.413 .604
Competence	.019	.075	.803	-.129 .166
Relatedness	.145	.044	.001	.059 .231
Novelty-variety	.243	.046	.000	.153 .333

D.9. Needs and components of Well-being.

Further exploratory analyses were conducted to look at the effect of the four needs on each individual component of well-being. We conducted multiple regressions with positive affect, negative affect, and vitality scores separately as dependent variables. The results can be found in Table D.7 and D.8 above.

For *Positive Affect*, a significant regression equation was found $F(4, 392)= 82.548$, $p<.001$, with R^2 of .457. Three of the four needs predicted unique variance in Positive Affect, including novelty-variety ($b=.132$, $p= .005$). Once again, competence did not reach significance. For *Negative Affect*, a significant regression equation was found $F(4,392)= 32.622$, $p<.001$, with R^2 of .250. The three SDT needs predicted Negative Affect (see Table __) while novelty-variety was not a significant predictor, ($b=.001$, $p=.976$). For *Vitality* ratings, a significant regression equation was found $F(4,392)= 99.117$, $p<.001$, with R^2 of .503. novelty-variety was a significant and positive predictor of vitality ($b=.234$, $p<.001$). Thus overall, novelty-variety contributed independently to participants' Positive Affect and Vitality ratings, but not to Negative affect. The effects of novelty-variety also appeared to be similar to the other needs, being a larger predictor of Vitality scores than relatedness, and having similar effects on Positive Affect compared to relatedness. The effects of novelty-variety also appear to be more important than the effects of competence in our sample.

Appendix E: Study 3 Analyses

Table E.1.

Bonferroni Post hoc test with novelty-variety as the dependent variable

(I) Condition	(J) Condition	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower	Upper
NS	-N	1.00317*	.16721	.000	.5599	1.4465
	-R	.23931	.16843	.937	-.2072	.6858
	-A	.37330	.16843	.163	-.0732	.8198
-N	NS	-1.00317*	.16721	.000	-1.4465	-.5599
	-R	-.76387*	.16843	.000	-1.2104	-.3173
	-A	-.62988*	.16843	.001	-1.0764	-.1833
-R	NS	-.23931	.16843	.937	-.6858	.2072
	-N	.76387*	.16843	.000	.3173	1.2104
	-A	.13399	.16965	1.000	-.3158	.5838
-A	NS	-.37330	.16843	.163	-.8198	.0732
	-N	.62988*	.16843	.001	.1833	1.0764
	-R	-.13399	.16965	1.000	-.5838	.3158

*. The mean difference is significant at the 0.05 level.

Table E.2.

Bonferroni Post hoc test with relatedness as the dependent variable.

(I) condition	(J) condition	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	Upper Bound
NS	-N	.01270	.16282	1.000	-.4189	.4443
	-R	.95593*	.16401	.000	.5211	1.3907
	-A	.02782	.16401	1.000	-.4070	.4626
-N	NS	-.01270	.16282	1.000	-.4443	.4189
	-R	.94323*	.16401	.000	.5084	1.3780
	-A	.01513	.16401	1.000	-.4197	.4499
-R	NS	-.95593*	.16401	.000	-1.3907	-.5211
	-N	-.94323*	.16401	.000	-1.3780	-.5084
	-A	-.92810*	.16519	.000	-1.3661	-.4902
-A	NS	-.02782	.16401	1.000	-.4626	.4070
	-N	-.01513	.16401	1.000	-.4499	.4197
	-R	.92810*	.16519	.000	.4902	1.3661

*. The mean difference is significant at the 0.05 level.

Table E.3.

Bonferroni Post hoc test with relatedness as the dependent variable.

(I) condition	(J) condition	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	Upper Bound
NS	-N	.07937	.15831	1.000	-.3403	.4991
	-R	.02493	.15947	1.000	-.3979	.4477
	-A	.88768*	.15947	.000	.4649	1.3105
-N	NS	-.07937	.15831	1.000	-.4991	.3403
	-R	-.05444	.15947	1.000	-.4772	.3684
	-A	.80831*	.15947	.000	.3855	1.2311
-R	NS	-.02493	.15947	1.000	-.4477	.3979
	-N	.05444	.15947	1.000	-.3684	.4772
	-A	.86275*	.16063	.000	.4369	1.2886
-A	NS	-.88768*	.15947	.000	-1.3105	-.4649
	-N	-.80831*	.15947	.000	-1.2311	-.3855
	-R	-.86275*	.16063	.000	-1.2886	-.4369

*. The mean difference is significant at the 0.05 level.

Table E.4.

Correlations between the four needs.

Need	1	2	3	4
autonomy	1.000	.479**	.324***	.481**
competence		1.000	.309**	.508**
relatedness			1.000	.287**
novelty-variety				1.000

p< .05*, p< .01**, p<.001***

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