

**Title: EXPLORING THE NECESSARY ROLES OF BASIC PSYCHOLOGICAL
NEEDS AT WORK: A NECESSARY CONDITION ANALYSIS**

Short title: ARE BASIC PSYCHOLOGICAL NEEDS NECESSARY?

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Exploring the Necessary Roles of Basic Psychological Needs at Work: A Necessary Condition Analysis

Abstract

Self-determination theory (SDT) postulates that all humans have basic psychological needs for autonomy, competence, and relatedness. SDT scholars employ a necessity logic to define and interpret the roles of psychological need satisfaction for optimal human development. However, traditional regression techniques, often applied to test hypotheses derived from SDT, are unsuitable for testing necessity statements. To achieve a theory-method alignment, we employed necessary condition analysis (NCA) to examine whether basic psychological needs at work are necessary for employees' intrinsic motivation, identified regulation, life satisfaction, and vigor at work. Study 1's cross-sectional data (N = 550; Germany) and Study 2's time-lagged data (N = 417; U.K. and U.S.) generally support the necessary roles of need satisfaction. Notably, intrinsic motivation and vigor are especially constrained by basic psychological need satisfaction. This research advances SDT by providing more precise accounts of the theory from a necessity-oriented lens. We also highlight the importance of management practices that can satisfy employees' basic psychological needs at work.

Keywords: basic psychological needs, motivation, well-being, self-determination theory, necessity, necessary condition analysis

Self-determination theory (SDT) is a widely applied macro theory about human motivation and addresses the link between environmental factors and people's thriving through psychological need satisfaction (Deci et al., 2017; Gagné & Deci, 2005; Ryan & Deci, 2017). SDT maintains that all humans have three basic psychological needs: autonomy, competence, and relatedness, the satisfaction of which promotes intrinsic motivation, internalization, and well-being (Ryan, 1995; Van den Broeck et al., 2016). Autonomy refers to the "experience of volition, willingness, and authenticity in one's actions, thoughts, and feelings" (Vansteenkiste et al., 2023, p. 85). Competence reflects the "experience of effectiveness and mastery" (Vansteenkiste et al., 2023, p. 85). Relatedness denotes the "experience of warmth, bonding, and care and is satisfied when one feels connected to significant others" (Vansteenkiste et al., 2023, p. 85). Theoretical arguments regarding the importance of the three needs are summarized in basic psychological needs theory (BPNT) within the broader framework of SDT. Basic psychological needs have been increasingly utilized in organizational contexts, with abundant evidence suggesting their positive roles in enhancing employees' well-being, motivation, and performance (Deci et al., 2017; Ryan et al., 2022; Slemp et al., 2024; Van den Broeck et al., 2016).

Many other motivation theories also involve the term "need" and assume that need satisfaction "will be associated with more effective performance and well-being" (Gagné & Deci, 2005, p. 343). However, SDT scholars define needs in a more restrictive and narrow way (Ryan & Brown, 2003; Vansteenkiste et al., 2020). Basic psychological needs are defined as nutrients "that are *necessary* [emphasis added] for effective, healthy functioning" (Deci et al., 1996, p. 172). To rephrase, SDT's basic psychological needs "must be satisfied for optimal functioning and well-being" (Gagné & Deci, 2005, p. 343). Therefore, the necessary nature of

basic psychological needs constitutes an important difference between SDT and other theories of needs and motivation. This necessity further explains why need satisfaction is important for human thriving and flourishing.

However, we have relatively limited empirical studies examining the necessary roles of basic psychological needs due to theory-method misfit. Regression-based tools, commonly adopted in the SDT literature, are unsuitable for examining necessary conditions as they represent a probabilistic additive sufficiency logic. Specifically, in regression models, no conditions (or variables) are assumed to be necessary that must be present because each determinant compensates for the other, and the effects of determinants are interchangeable (Ding & Kuvaas, 2023; Dul, 2016). The absence of one determinant may cause a decrease in the outcome; however, increasing other determinants' values can compensate for its absence. This additive sufficiency logic contrasts the necessity logic, where the outcome is impossible or constrained when a necessary condition is absent because other conditions cannot compensate for the absence of a necessary condition.

Therefore, Dul (2016) proposes necessary condition analysis (NCA) as a general methodology to test necessity statements. NCA does not answer how changes in a factor relate to the outcome's change; instead, it examines whether the outcome does not occur when an assumed necessary condition is absent (Dul et al., 2023). The emergence of NCA enables us to test the long-standing necessity claims in SDT. However, to our knowledge, only two papers (Ding & Kuvaas, 2023; Neubauer, 2022) utilized NCA to test the necessity of basic psychological needs. However, both are methodological papers primarily for demonstrating the NCA methodology without offering a deep theoretical analysis of basic psychological needs'

necessity nature. Accordingly, their empirical scopes are quite narrow, focusing only on well-being within a limited sample (i.e., college students and soldiers).

The current paper aims to solve these limitations by employing the NCA to test whether three basic psychological needs are *necessary* for employees' optimal development, as reflected by intrinsic motivation, identified regulation, life satisfaction, and vigor. By so doing, we make theoretical, empirical, and methodological contributions to the SDT literature. First, we advance scholarly understanding of the necessary nature of basic psychological needs. Our in-depth theoretical analysis reveals that necessity logic is frequently adopted in defining SDT's needs and explaining the importance of need satisfaction. We also highlight that sufficiency and necessity are two different logics, and researchers should be aware of their differences when crafting and testing theoretical arguments.

Second, by employing NCA, we empirically examine the necessity propositions regarding need satisfaction to solve the long-standing mismatch between SDT's necessity statements and the statistical tools applied to test them. Moreover, our findings have important practical implications because NCA allows us to identify the most critical factors that must be satisfied for employees' optimal development. Without satisfying these necessary conditions, all other managerial practices designed to achieve employees' flourishing and thriving will be less effective.

Third, we also make a methodological contribution by showcasing the value of NCA in SDT (Bergh et al., 2022). NCA can bring major changes to both theory and practice by identifying necessary conditions for a given outcome or phenomenon (Aguinis et al., 2020; Dul et al., 2023). Moreover, NCA has the potential to reach a wide audience in organizational

psychology. As Goertz (2003) pointed out, important necessary condition hypotheses can exist in any research area, indicating the broad applicability of the necessity logic.

The Deterministic Necessity Logic in Basic Psychological Needs

SDT scholars frequently use words that clearly and directly convey a necessity logic (e.g., “necessary,” “prerequisite,” and “must”) to propose statements regarding basic psychological needs. Indeed, a necessity logic has been tightly embedded in the definition of needs. In SDT, needs are defined as “conditions or inputs that are *necessary* [emphasis added] for growth, health, and integrity” (Ryan, 1995, p. 421). To better illustrate the necessary nature of psychological needs, Ryan and Deci (2017) analogize them to basic physiological needs. Just like people have basic physiological needs for oxygen, clean water, and adequate nutrition that are required for bodily health and safety, Ryan and Deci assert that “there are also basic psychological needs that *must* [emphasis added] be satisfied for psychological interest, development, and wellness to be sustained” (p. 10).

This necessity nature becomes more evident when SDT scholars illustrate the consequences of need deprivation. As Deci and Ryan (2000) assert, “each of these three needs plays a necessary part in optimal development so that none can be thwarted or neglected without significant negative consequences” (p. 229). Hence, they claim that achieving optimal development “requires satisfaction of all three needs; one or two are not enough” (p. 229). Necessity logic is unique to SDT’s needs and does not apply to other so-called needs outside the SDT framework. Using a thought experiment, Deci and Ryan state that countless people can achieve psychological integrity and health “without having the so-called needs for power, acquisitiveness, or self-abasement well satisfied” (p. 229). By contrast, they assert that it is

impossible to imagine people with optimal, healthy development “in which a need for autonomy, relatedness, or competence was neglected” (p. 229).

In summary, a deterministic (or “quasi-deterministic” if allowing a few exceptions; see Dul, 2024a; Lee & Lu, 2023) necessity logic is firmly rooted in SDT’s basic psychological needs. Unlike many prior empirical studies on basic psychological needs (Devloo et al., 2015; Dysvik et al., 2013; Greguras & Diefendorff, 2009; Olafsen et al., 2018), our research is motivated by the aim to test their necessary roles using NCA. Specifically, we focus on three key indicators of optimal human growth and development: (a) intrinsic motivation, (b) internalization and integration, and (c) vitality and wellness (Ryan & Deci, 2017).

Below, we provide theoretical justifications for the necessary relationships between need satisfaction and three indicators of optimal development. Notably, formulating necessity hypotheses differs from developing typical sufficiency-based hypotheses (Bokrantz & Dul, 2023; Richter & Hauff, 2022). We build necessity hypotheses by explaining why employees with, for example, high intrinsic motivation almost always have high autonomy, competence, and relatedness; why employees rarely have high intrinsic motivation if any of these basic needs are not satisfied; and why other factors cannot compensate for the absence of any basic need.

Intrinsic Motivation

Intrinsic motivation describes the drive to work for its own sake to experience the interest and enjoyment inherent in it (Deci et al., 2017; Deci & Ryan, 1985). Autonomy provides a feeling of authenticity and ownership over one’s job, which helps sustain intrinsic motivation. Lack of autonomy will constrain intrinsic motivation, and other factors cannot compensate for it because autonomy, or being in control of one’s fate, is a basic drive for motivated behaviors (DeCharms, 1968).

Employees who are intrinsically motivated at work usually experience high levels of competence satisfaction. Feelings of mastery, accomplishment, and effectiveness can constitute a strong reason for work (Elliot & McGregor, 2001). The belief that one's efforts and behaviors can have intended effects is emphasized in almost every motivation theory (Bandura, 1989; Ryan & Moller, 2017). Therefore, the feeling that being incapable of making progress or achieving goals can restrict the levels of enjoyment that employees get from work.

Relatedness satisfaction fosters a sense of belonging, bonding, and care, which constitutes another source for motivating behaviors (Deci & Ryan, 2014). Humans are social animals, and employees must engage in interpersonal and social interactions to accomplish work (Ferris et al., 2009). Feeling valued, understood, and supported by others enhances engagement and enjoyment at work; conversely, feeling isolated and disconnected can lead to apathy and a lack of intrinsic drive in work. Experiencing optimal enjoyment will be difficult when employees lose a secure relational base at work (Ryan & Deci, 2017). Therefore, we propose the following:

Hypothesis 1: Satisfying basic psychological needs for autonomy (a), competence (b), and relatedness (c) is necessary for intrinsic motivation.

Psychological Internalization

Psychological internalization describes how employees internalize and integrate external regulations, norms, and practices. We use identified regulation as an indicator of psychological internalization, which refers to recognizing or identifying the meanings behind one's work behavior (Gagné et al., 2015). Internalizing motivation at work is important because not all work tasks can be enjoyable and intrinsically motivate employees (Ryan & Deci, 2017).

We theorize that autonomy, competence, and relatedness will be necessary for identified regulation. Identified regulation is a type of autonomous motivation where the reasons for

engaging in jobs are still more internalized and self-determined, such as personal importance and meaningfulness (Deci & Ryan, 2000). Therefore, having an internal locus of causality (i.e., feeling that behaviors and actions are internally driven) seems to be a precondition for identified regulation. Feeling controlled will impair the formation of autonomous motivation.

Identified regulation may also require competence and relatedness satisfaction (Vansteenkiste et al., 2020). Lacking competence does not provide a sufficient drive to internalize work motivation. Working to feel connected with important others (e.g., colleagues, supervisors, and clients) is also a critical drive to build personal significance and identification with work. The internalization process will be hampered when the work environment is hostile, and employees feel disconnected from those encouraging these goals. Therefore, we propose:

Hypothesis 2: Satisfying basic psychological needs for autonomy (a), competence (b), and relatedness (c) is necessary for identified regulation.

Well-being

Many necessity claims regarding basic psychological needs are made with well-being (Ryan & Deci, 2017; Van den Broeck et al., 2016; Vansteenkiste et al., 2020). Well-being is usually operationalized from hedonic and eudaimonic perspectives (Martela & Ryan, 2023; Ryan & Deci, 2001). The hedonic view focuses on experienced happiness and pleasure (e.g., life satisfaction, positive affect, and absence of negative affect; Diener, Suh, Lucas, & Smith, 1999). Nevertheless, well-being is not just about happiness, as it cannot fully gauge human functioning and flourishing (Ryan et al., 2008; Ryan & Deci, 2017; VanderWeele et al., 2020). SDT emphasizes eudaimonic well-being, viewing true well-being as a state of using one's capabilities and energies to engage in meaningful, valued, and coherent living (e.g., vigor or vitality; Ryan &

Deci, 2001). Therefore, we use life satisfaction and work-related vigor to measure employee well-being.

We assume work-related need satisfaction will be necessary for employee life satisfaction and vigor. Work is central to most adults' lives, defining their identity and shaping their personal well-being (Deci & Ryan, 1985). Any unmet work-related basic psychological needs may negatively spill over into one's personal life, hindering high life satisfaction. Moreover, basic needs have functional meanings for people's thriving and flourishing (Martela, 2023; Ryan & Martela, 2016). It will be difficult for employees to engage in jobs vigorously and wholeheartedly when they feel controlled, frustrated, or isolated. Therefore, we hypothesize:

Hypothesis 3: Satisfaction of basic psychological needs for autonomy (a), competence (b), and relatedness (c) is necessary for life satisfaction.

Hypothesis 4: Satisfaction of basic psychological needs for autonomy (a), competence (b), and relatedness (c) is necessary for vigor at work.

The Probabilistic Sufficiency Logic in Basic Psychological Needs

Although the main focus of this paper is to explore the necessity logic in basic psychological needs, we mention briefly the sufficiency logic in understanding need satisfaction to better distinguish the two logics. A probabilistic sufficiency perspective is a common lens for understanding causation in social science research (Dul, 2024; Rohlfing & Zuber, 2021), and many researchers also apply this perspective in interpreting the roles of need satisfaction in BPNT. Unlike the necessity logic, which focuses on the absence of positive outcomes when any basic psychological need is not satisfied, the sufficiency logic emphasizes the occurrence of positive outcomes when psychological needs are satisfied. For example, a probabilistic sufficiency statement formulated by SDT scholars is that basic psychological needs "*facilitate*

[emphasis added] autonomous motivation, psychological and physical wellness, and enhanced performance” (Deci et al., 2017, p. 23). Therefore, from a probabilistic sufficiency view, we can view basic psychological needs as “nice-to-have” factors: Their satisfaction will likely bring about many positive employee outcomes. However, “nice-to-have” factors may not be necessary because other factors may compensate for their absence.

Most researchers embrace this sufficiency logic when examining the positive roles of need satisfaction using regression-based techniques in empirical studies. Regression-analytical methods commonly imply a probabilistic view of the relationships investigated as they examine the average effects (Dul, 2016, 2024). For example, positive coefficient estimates in regression models suggest that, on average, when levels of need satisfaction increase, levels of positive outcomes will also increase. Nevertheless, regression methods do not tell us whether the outcome is absent if one basic psychological need is not satisfied.

SDT’s propositions regarding three basic psychological needs have always touched upon both sufficiency and necessity logic. However, the current SDT literature has not clearly acknowledged such a distinction, which we believe is a problem because sufficiency and necessity have different implications and require different analytical tools for testing. It is important to examine the “sufficiency” part of SDT by regression-based approaches, as most SDT researchers have done (Battaglio et al., 2022; Van den Broeck et al., 2016). These results support the contributory roles of need satisfaction for optimal development, reflecting a sufficiency logic. However, we have comparatively fewer empirical studies examining the necessity of need satisfaction using NCA. Therefore, the analyses below aim to fill this gap.

Transparency and Openness: Overview of the Studies

To test our hypotheses, we conducted two studies. In Study 1, we adopted a publicly available cross-sectional data set from Grünwald et al.'s (2024) study, for which we obtained permission to reuse the data. Study 1 participants were 550 German full-time employees. Since Study 1 is based on cross-sectional data and may be susceptible to common method bias, we conducted a two-wave survey in Study 2. Study 2 involves 417 full-time U.K. and U.S. employees recruited from Prolific, a widely used online crowd-sourcing research platform that has been proven to provide high-quality data (Peer et al., 2022). Study 2 involves processing personal data (i.e., using participants' Prolific IDs to match two waves of data). Therefore, we submitted a notification form regarding the handling of personal data to the Norwegian Agency for Shared Services in Education and Research and received their approval (notification form: 677992; title: "work characteristics and motivation"). We have also obtained consent from participants to process their data. Power analysis indicates that the sample sizes of Studies 1 and 2 can provide enough statistical power (commonly set at .80) to detect a necessary condition (Dul, 2021).¹ The data, reproduction materials, and additional results for both studies can be found in an Open Science Framework (OSF) repository: https://osf.io/24dgp/?view_only=1851645b187c4537a331bcff333b5a03. We also present additional analyses there as well. For example, at points in the review process, we examined whether autonomous motivations (i.e., intrinsic motivation and identified regulation) are necessary for vigor at work. Although these analyses are not part of the proposed hypotheses, we present these results at OSF.

¹ We set several assumptions for conducting the power analysis: an assumed population effect size of .1, a ceiling slope of 1, a truncated normal distribution for points below the ceiling, the CE-FDH ceiling line as the ceiling technique, and a threshold p-value of .05.

Study 1: Method

Participants and Procedure

Participants were recruited from social networks and German universities and came from various occupations in Germany (Grünwald et al., 2024). All variables were measured at one time point with two attention-check questions being used to ensure data quality. We only used data from full-time employees. The final sample consists of 550 participants. Of these individuals, 386 identified as female. On average, participants were 29.11 years old ($SD = 9.40$).

Measures

All measures were translated into German version using a back-translation procedure (Brislin, 1970).

Basic Psychological Need Satisfaction

Autonomy, competence, and relatedness satisfaction were measured using the German version of the Work-related Basic Need Satisfaction scale (W-BNS; 1 = totally disagree, 5 = totally agree) developed by Van den Broeck et al. (2010). A sample item for autonomy is “I feel free to do my job the way I think it could best be done.” A sample item for competence is “I really master my tasks at my job.” A sample item for relatedness is “At work, I feel part of a group.”

Intrinsic Motivation

Intrinsic motivation was measured using the Multidimensional Work Motivation Scale (MWMS; 1 = not at all to 7 = completely) developed by Gagné et al. (2015). These items start with the introduction, “Why do you or would you put efforts into your current job?” A sample item for intrinsic motivation is “because I have fun doing my job.”

Identified Regulation

Identified regulation was measured using the MWMS (1 = not at all to 7 = completely). A simple item is “because I personally consider it important to put efforts in this job.”

Life Satisfaction

Life satisfaction was measured using the five-item Satisfaction With Life Scale (SWLS; 1= strongly disagree, 7 = strongly agree) developed by Diener et al. (1985). A sample item is “I am satisfied with my life.”

Vigor

Vigor was measured using the three-item vigor subscale from the shortened Utrecht Work Engagement Scale (UWES; Sautier et al., 2015; 1 = never to 7 = always). A sample item is “At my work, I feel bursting with energy.”

Analytic Strategy

Descriptive statistics, reliabilities, and correlations were shown in Table 1. We first performed confirmatory factor analyses (CFA) to demonstrate the distinctiveness of the measures using R package lavaan (version 0.6-17) with maximum likelihood estimation. The measurement model includes seven latent variables, showing an overall good fit to the data ($\chi^2 = 1062.43$, $df = 443$, CFI = .93, TLI = .93, RMSEA = .05, SRMR = .05). The measurement model is superior to alternative models (see our OSF Appendix).

We used the R package NCA (version 4.0.1) to test the hypotheses. We conducted analyses and reported results based on recent guidelines for good NCA practice (Dul et al., 2023). In particular, we adopted a quasi-deterministic or typicality perspective in the analysis, which allows us to detect and remove outliers (Dul, 2024; Lee & Lu, 2023). This practice has two main advantages. First, a quasi-deterministic perspective aligns better with social realities than an absolute view on necessity: Necessity theories suggest that almost all cases must fulfill

the necessary condition to achieve the desired outcome despite a few exceptions (Lee & Lu, 2023). Second, NCA is sensitive to outliers, which may mask a necessity effect and substantively change research conclusions if not removed (Dul, 2021, 2024; Dul et al., 2023). We removed the outliers if their removal could change the original effect size by 20% or more (Van Iddekinge et al., 2023). To ensure data transparency, we limited the maximum number of outliers removed in an analysis to 1% of the sample size and reported the original effect sizes as well (Aguinis et al., 2013).

The existence of a necessary condition is indicated by an empty upper-left area in an X-Y scatter plot. This blank zone highlights the constraint that low X has on high Y, indicating that a certain level of X must be met to achieve high Y. Otherwise, low X becomes a bottleneck for achieving high Y. By contrast, a lower-right blank area indicates sufficiency, suggesting that a certain level of X is sufficient (or guaranteed) to achieve a certain level of Y (Ding & Kuvaas, 2023). In the case of a perfect correlation between X and Y, X is considered a sufficient and necessary condition for Y.

NCA generally uses two techniques to draw a ceiling line to capture such a blank space: ceiling envelopment with a free disposal hull (CE-FDH) and ceiling regression with a free disposal hull (CR-FDH). CE-FDH generates a piece-wise line, while CR-FDH generates a straight line. CE-FDH is preferred over CR-FDH under the following conditions (Ding, 2022; Dul, 2016): (a) the variables are dichotomous or discrete with a variable level smaller than five; (b) a straight ceiling line does not properly represent the data around the ceiling line (e.g., nonlinearity of the border). We reported NCA results based on CE-FDH because the data around the ceiling lines did not follow a linear pattern; therefore, a piece-wise line captured this trend more precisely than a straight line.

Interpreting NCA results mainly relies on two parameters: effect size (d) and significance level (p). The effect size d = the size of the space above the ceiling (i.e., the blank zone)/the total space that can contain observations given the minimum and maximum values of the condition and the outcome. The effect size represents how much the necessary condition constrains the outcome: The necessity effect is stronger if the blank zone is larger. Dul (2016) recommends using .1 as the threshold to claim a practically relevant or meaningful necessary condition. However, determining a universal threshold remains challenging (Ding & Kuvaas, 2023). Instead of making a dichotomous judgment, we view practical relevance as a matter of degree (e.g., small, medium, and large). Therefore, we report the effect size along with the classification system made by Dul (2016) to help readers understand the practical significance of the findings.

Another important NCA parameter is the significance level (p), which evaluates the probability that the observed effect size d (or the empty zone) is due to random chance. Dul et al. (2020) introduced the permutation test to reject the null hypothesis of an NCA effect being due to randomness. The permutation test generates a p -value, informing us of the possibility of NCA effects being attributed to randomness. We conducted 10,000 resamples in the statistical approximate permutation test for calculating the p -value of each NCA analysis. Similar to regression analysis, p -value < .05 represents a statistically significant result.²

Study 1: Results

We presented NCA results in Table 2 and NCA plots in Figure 1. Hypothesis 1 theorized that autonomy (a), competence (b), and relatedness (c) satisfaction are necessary for intrinsic motivation. NCA results show that autonomy ($d = .23, p < .01$), competence ($d = .21, p < .01$),

² For more detailed explanations of the NCA methodology, please refer to Dul (2016, 2021) and Dul et al. (2020, 2023).

and relatedness ($d = .19, p < .01$) satisfaction have significant effect sizes for intrinsic motivation, supporting H1a, H1b, and H1c.

Moreover, NCA also allows for making necessity statements in degrees, telling us specific levels of conditions that are required (or necessary) for specific levels of the outcome. Table 3 presents a bottleneck table, showing levels of basic needs that must be fulfilled to achieve specific levels of intrinsic motivation. For example, to achieve a maximum level of intrinsic motivation, the minimum levels of autonomy, competence, and relatedness satisfaction are 3, 3.5, and 3 on a 5-point scale. When either of the basic need levels falls below the respective threshold, no participants reported reaching the maximum level of intrinsic motivation. We added bottleneck tables of other significant necessary conditions in the Appendix.

Hypothesis 2 theorized that autonomy (a), competence (b), and relatedness (c) satisfaction are necessary for identified regulation. NCA results show that competence ($d = .13, p < .01$) and relatedness ($d = .06, p < .05$) satisfaction have significant effect sizes for identified regulation, supporting H2b and H2c. However, autonomy satisfaction ($d = .06, p = .11$) does not have a significant effect size, failing to support H2a.

Hypothesis 3 theorized that autonomy (a), competence (b), and relatedness (c) satisfaction are necessary for life satisfaction. NCA results show that autonomy ($d = .11, p < .01$) competence ($d = .12, p < .01$), and relatedness ($d = .11, p < .01$) satisfaction have significant effect sizes for life satisfaction, supporting H3a, H3b, and H3c.

Hypothesis 4 theorized that autonomy (a), competence (b), and relatedness (c) satisfaction are necessary for work-related vigor. In support of Hypothesis 4a, 4b, and 4c,

autonomy ($d = .27, p < .01$), competence ($d = .25, p < .01$), and relatedness satisfaction ($d = .28, p < .01$) have significant NCA effect sizes for vigor.³

Study 2: Method

Participants and Procedure

Study 1 relied on cross-sectional data, which may be susceptible to common method bias (Podsakoff et al., 2024). To address this issue, we incorporated a two-week temporal separation between the measurement of basic psychological needs (Time 1) and outcome variables (Time 2) in Study 2. We used Prolific's screeners to select eligible participants (i.e., high English fluency and full-time employment) from the United States and the United Kingdom. We informed participants of the survey procedure at Time 1 and sent them a reminder via Prolific's built-in message when the Time 2 survey was available to reduce attrition. Participants who completed two waves of surveys could get approximately \$ 0.84 in total.

Following previous suggestions on using online survey platforms (Aguinis et al., 2021), we designed three data-screen tools for the second-wave survey. First, we designed one open-ended attention check question during the second wave survey ("Please describe your overall attitude or feelings toward your work"). If a participant entered a meaningless answer, it was considered invalid. Second, we asked participants to self-rate the truthfulness of their answers ("My answers in this survey fully reflect what I think in my mind") on a seven-point scale (1 = strongly disagree; 7 = strongly agree). We deleted answers from participants who did not "strongly agree" or "agree" with the truthfulness of their answers. Third, we asked participants to

³ We removed three outliers in testing Study 1's H1b, H2b, and H4c; two outliers in testing H3b and H3c; and one outlier in testing H1c, H2c, and H3a. The original effect sizes, without removing these outliers, were as follows: H1b: $d = .03, p = .54$; H1c: $d = .15, p < .01$; H2b: $d = 0, p = 1$; H2c: $d = .04, p = .10$; H3a: $d = .07, p = .16$; H3b: $d = .07, p = .07$; H3c: $d = .08, p < .05$; H4c: $d = .17, p < .01$.

self-report their current employment status (e.g., “has always been a full-time employee during the whole survey period,” “changed employment status,” or “was not a full-time employee”). We only included data from participants who reported being full-time employees throughout the entire survey period. For the second and third questions, we informed participants that their answers were unrelated to compensation to exclude those who misrepresented themselves to get compensation.

The first wave survey collected answers from 503 employees, and 431 participated in the second wave survey. All the participants passed the attention check question, but 11 self-reported low truthfulness of their answers, and four reported employment status inconsistent with our study criteria. The final sample size is 417 after deleting these invalid answers. Of these individuals, 214 identified as female. On average, participants were 38.88 years old ($SD = 10.90$).

Measures

Participants responded to the items based on their feelings “in general” as we aimed to capture necessity relationships at a general and overarching level.

Basic Psychological Need Satisfaction (Time 1)

We measured need satisfaction at work using the same scale as in Study 1.

Intrinsic Motivation (Time 2)

We measured intrinsic motivation using the same scale as in Study 1.

Identified Regulation (Time 2)

We measured identified regulation using the same scale as in Study 1.

Life Satisfaction (Time 2)

We measured life satisfaction using a face-valid item (i.e., “I am satisfied with my life”) from the SWLS. Life satisfaction is a conceptually narrow and unidimensional construct; therefore, it can be measured accurately and reliably with a single item (Fuchs & Diamantopoulos, 2009; Matthews et al., 2022). Empirical evidence suggests that a single item relates strongly with a multi-item measure of life satisfaction (Cheung & Lucas, 2014; Jovanović & Lazić, 2020).

Vigor (Time 2)

We measured work-related vigor ($\alpha = .90$) using the same scale as in Study 1.

Analytic Strategy

Descriptive statistics, reliabilities, and correlations were shown in Table 4. As in Study 1, we first performed CFA using R package lavaan with maximum likelihood estimation. The measurement model includes six latent variables, showing an overall good fit to the data ($\chi^2 = 694.48$, $df = 260$, CFI = .94, TLI = .93, RMSEA = .06, SRMR = .06). The measurement model is superior to alternative models (see our OSF Appendix). We used the R package NCA to test the hypotheses.

Study 2: Results

We presented NCA results in Table 2 and NCA plots in Figure 2. NCA results for Hypothesis 1 show that autonomy ($d = .21$, $p < .01$), competence ($d = .45$, $p < .01$), and relatedness satisfaction ($d = .12$, $p < .01$) have significant effect sizes for intrinsic motivation, providing support for H1a, H1b, and H1c.

NCA results for Hypothesis 2 show that autonomy ($d = .12, p < .01$), competence ($d = .37, p < .01$), and relatedness ($d = .07, p < .05$) satisfaction have significant effect sizes for identified regulation, providing support for H2a, H2b, and H2c.

NCA results for Hypothesis 3 show that autonomy ($d = .08, p < .05$), competence ($d = .29, p < .05$), and relatedness ($d = .11, p < .01$) satisfaction have significant effect sizes for life satisfaction, providing support for H3a, H3b, and H3c.

NCA results for Hypothesis 4 show that autonomy ($d = .26, p < .01$), competence ($d = .44, p < .01$), and relatedness satisfaction ($d = .16, p < .01$) have significant effect sizes for work-related vigor, providing support for H4a, H4b, and H4c.⁴

General Discussion

A fundamental assumption in SDT is that basic psychological needs are universally necessary for human thriving and flourishing (Deci et al., 2017; Deci & Ryan, 2000; Ryan & Deci, 2000b). This necessity logic in SDT has not been properly tested until the emergence of NCA. We achieve a theory-method-data fit (Bliese et al., 2024) in testing whether autonomy, competence, and relatedness satisfaction are necessary for intrinsic motivation, identified regulation, life satisfaction, and vigor. Across two studies, our findings are in large supportive of the necessary roles of basic psychological needs. Our work goes beyond vague, untested necessity statements in SDT and contributes to an explicit and sophisticated need satisfaction theory.

⁴ We removed one outlier in testing Study 2's H2a, H2b, H2c, H3a, H3c, and H4c. The original effect sizes, without removing these outliers, were as follows: H2a: $d = .08, p < .01$; H2b: $d = .30, p < .01$; H2c: $d = .05, p = .06$; H3a: $d = 0, p = 1$; H3c: $d = .07, p < .01$; H4c: $d = .13, p < .05$.

Theoretical Contributions

First, we examine basic psychological need satisfaction from a necessity logic, which is firmly embedded in SDT. This necessity approach differs from previous regression-based empirical explorations that usually followed a sufficiency logic and examined the positive roles of different ways of need satisfaction on desirable outcomes, such as exploring additive, synergistic, and balanced effects of need satisfaction (Dysvik et al., 2013). In particular, the necessity nature of needs may help explain why balanced need satisfaction matters for well-being (Milyavskaya et al., 2009; Sheldon & Niemiec, 2006). Unbalanced need satisfaction indicates that one or two needs are not well satisfied. However, we found that each need is necessary for vigor and life satisfaction. Therefore, the negative effect of having one need not well satisfied may constrain well-being. Besides, our results support that each need is independently necessary and should be considered separately (Ryan & Deci, 2000b). Therefore, our findings are consistent with a meta-analytic study's (Van den Broeck et al., 2016) conclusion that averaging autonomy, competence, and relatedness together is inappropriate. Our results oppose a bifactor analytical study's (Sánchez-Oliva et al., 2017) suggestion that autonomy items should be used primarily for assessing global need satisfaction instead of a separate assessment of autonomy satisfaction.

Second, we contribute to a nuanced understanding of the prerequisites for employees' autonomous motivation. In both studies, intrinsic motivation requires autonomy, competence, and relatedness satisfaction. Therefore, our results oppose Fishbach and Woolley's (2022) argument that autonomy is not a necessary condition for experiencing intrinsic motivation. Notably, relatedness satisfaction is also critical in sustaining intrinsic motivation, although theorized to play a more distal role than autonomy and competence (Deci & Ryan, 2000; Dysvik

et al., 2013). The expression of intrinsic motivation appears to depend on having a stable and secure relationship base (Ryan & Deci, 2000a). In terms of identified regulation, competence satisfaction consistently shows larger effect sizes ($d = .13$ and $.37$) than autonomy and relatedness in both studies. Autonomy and relatedness satisfaction place weaker constraints on identified regulation compared to their constraints on intrinsic motivation. Therefore, our results highlight the essential role of competence satisfaction in experiencing identified regulation.

Third, we also emphasize the necessity of need satisfaction for well-being. In both studies, all three basic psychological needs show medium or large effect sizes (d ranges from $.16$ to $.44$) on work-related vigor. Echoing SDT's emphasis on eudaimonic well-being, this finding is similar to the result of a prior study, where Ding and Kuvaas (2023) found that work engagement requires the satisfaction of all three needs. However, basic psychological need satisfaction at work shows relatively weak constraints on life satisfaction. For example, the effect sizes of autonomy and relatedness satisfaction span a range of $.08$ to $.11$ in both studies. These results suggest that domain-specific well-being may especially be constrained by domain-specific need satisfaction.

Fourth, we reveal the required levels of basic psychological needs that must be fulfilled for specific levels of the outcome by bottleneck analysis. For example, in Study 1, to achieve the maximum level of intrinsic motivation, the minimum levels of autonomy, competence, and relatedness (measured on a 5-point scale) are 3, 3.5, and 3, respectively (Table 3). It should be noted that the required levels for autonomy and relatedness are relatively low. This observation suggests that other factors may, to some extent, compensate for the low level of autonomy or relatedness in achieving intrinsic motivation. However, this kind of compensation only applies to areas below the ceiling line. Importantly, employees who can achieve the highest intrinsic

motivation with these minimum required levels are rare as they represent extreme or “best” cases (i.e., those on the ceiling line). Most individuals at these thresholds experience intrinsic motivation below the maximum level (i.e., cases below the ceiling line).

Practical Implications

The practical implications of identifying necessary conditions are readily apparent and valuable: All necessary conditions must be fulfilled first to allow the desired outcome to exist; otherwise, their absences will become bottlenecks preventing the outcome’s occurrence (Dul, 2021; Hauff et al., 2021). Specifically, our results indicate that satisfying employees’ basic psychological needs for autonomy, competence, and relatedness is necessary for autonomous motivation and well-being, especially for intrinsic and vigor. Thus, to make employees intrinsically motivated and stay vigorous at work, managers and organizations should implement practices promoting employees’ feelings of volition, effectiveness, and belonging. For example, information sharing, employee involvement in decision-making, and flexible job design can contribute to autonomy satisfaction (Jiang et al., 2012). Rigorous recruitment and selection, offering training and development opportunities, and constructive feedback are designed to make competent and skilled employees (Shaw, 2024). Leaders and organizations can foster a sense of belonging through teamwork, organizational social activities, and building an inclusive work environment.

Methodological Implications

New methods can bring new perspectives, allow us to test previously untestable or inappropriately tested theoretical propositions (Bliese et al., 2024), contribute to a more holistic understanding of the phenomena of interest (Nielsen et al., 2020), and ultimately move disciplinary knowledge forward (Bergh et al., 2022). NCA is not only a new data analysis tool,

but also represents a new logic and perspective in building theory and understanding organizational phenomena (Aguinis et al., 2020). NCA's necessity perspective informs us what will not happen in almost every observation if a necessary condition is absent (Dul, 2024). This is in contrast to regression-based tools that imply a probabilistic sufficiency logic. Regression methods focus on how the outcome changes on average in a group of observations when the condition changes. NCA and regression methods can complement each other in knowledge accumulation (Dul, 2016). Therefore, when researchers adopt regression analysis to reveal significant factors relevant to the outcome, they can also employ NCA to examine whether some factors are necessary. Besides, we also encourage researchers to develop theories via a necessity perspective to complement a probabilistic sufficiency logic widely adopted in theory building (Bokrantz & Dul, 2023; Ding & Kuvaas, 2023).

Limitations and Implications for Future Research

Our study has several limitations and suggestions for future research. First, the study design is observational, not experimental; therefore, we are unsure whether the significant NCA effect sizes reflect "necessity causality." Thus, future studies may consider conducting necessity experiments. For example, we can observe whether some levels of the outcome cannot be achieved after removing or reducing a proposed necessary condition (Dul, 2021).

Second, although two samples were used in the current paper, our results still need to be replicated, for example, in different cultures, given that psychological needs are theorized as a universal foundation for human optimal development in SDT (Vansteenkiste et al., 2020). Replication also involves using different measures of need satisfaction. We adopted W-BNS in both studies; however, this measure may be a little problematic as it uses reversed items, which may potentially capture need frustration (Van den Broeck et al., 2010). Besides, future studies

may broaden the employee outcomes to be investigated, given that need satisfaction is theorized to be a precondition for various psychological health and wellness outcomes (Deci & Ryan, 2000).

Third, researchers may explore the necessity roles of needs frustration's absence at work (Chen et al., 2015; Deci et al., 2017; Longo et al., 2018; Van den Broeck et al., 2016; Warburton et al., 2020). As Vansteenkiste et al. (2023) note, "the absence of need satisfaction does not necessarily imply the presence of need frustration" (p. 88). The presence of need frustration may restrict well-being's occurrence. For example, researchers can investigate whether the absence of (or low) need frustration at work is necessary for (high) intrinsic motivation (i.e., need frustration must be avoided to allow for high intrinsic motivation).

Fourth, NCA is also a valuable tool for evaluating other candidate needs. Researchers have been increasingly interested in whether we should add the fourth basic psychological need (e.g., novelty, beneficence, and morality; Vansteenkiste et al., 2020). NCA is a useful tool for considering the candidate needs because SDT originally defines needs from a necessity perspective (Gagné & Deci, 2005). If employees can achieve optimal development without a so-called "basic need" (i.e., this specific need is not a necessary condition), then it is hard to call it a "need," let alone a "basic" need. The necessity of a candidate need enables it to be legitimately considered a fundamental human need.

Conclusion

SDT scholars have been using a necessity logic to define basic psychological needs and interpret the positive role of need satisfaction for over three decades (Ryan, 1995; Ryan & Deci, 2000b). However, the long-standing necessity statements regarding three basic psychological needs in SDT have not been systematically tested until we employed NCA to ensure a theory-

method fit in the current paper. We advance scholarly understanding of the necessary roles of basic psychological needs for autonomy, competence, and relatedness. The findings and discussion of this study contribute to crafting more precise and explicit necessity theoretical propositions in SDT. Our study also explains why organizations should develop management practices to satisfy employees' needs for autonomy, competence, and relatedness.

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Table 1*Descriptive Statistics, Reliabilities, and Correlations for Study 1*

Variables	M	SD	1	2	3	4	5	6	7
1. Autonomy	3.27	0.73	(.78)						
2. Competence	4.17	0.62	.35**	(.84)					
3. Relatedness	3.72	0.77	.43**	.27**	(.79)				
4. Intrinsic motivation	4.72	1.56	.69**	.26**	.43**	(.93)			
5. Identified regulation	5.57	1.16	.43**	.20**	.31**	.60**	(.81)		
6. Life satisfaction	5.03	1.11	.33**	.28**	.29**	.31**	.23**	(.87)	
7. Vigor	4.27	1.23	.65**	.33**	.46**	.78**	.55**	.36**	(.88)

Note. N = 550. The alpha reliabilities are listed on the diagonal in parentheses.

* $p < .05$

** $p < .01$

Table 2*Results of NCA Effect Sizes in Studies 1 and 2*

Conditions	Intrinsic motivation		Identified regulation		Life satisfaction		Vigor at work	
	$d_{\text{Study 1}}$	$d_{\text{Study 2}}$	$d_{\text{Study 1}}$	$d_{\text{Study 2}}$	$d_{\text{Study 1}}$	$d_{\text{Study 2}}$	$d_{\text{Study 1}}$	$d_{\text{Study 2}}$
Autonomy	.23**	.21**	.06	.12**	.11**	.08*	.27**	.26**
Competence	.21**	.45**	.13**	.37**	.12**	.29*	.25**	.44**
Relatedness	.19**	.12**	.06*	.07*	.11**	.11**	.28**	.16**

Note. $N_{\text{Study 1}} = 550$ (Germany). $N_{\text{Study 2}} = 417$ (U.K. and U.S.). The p -value is based on 10,000

permutation resamplings. Results are based on CE-FDH. Classification system for NCA effect

size (d): small effect sizes: $0 < d < .1$; medium: $.1 \leq d < .3$; large effect size: $.3 \leq d < .5$; and

very large effect size: $d \geq .5$.

* $p < .05$

** $p < .01$

Table 3*Bottleneck Table for Basic Psychological Needs and Intrinsic Motivation in Study 1*

Intrinsic motivation	Autonomy	Competence	Relatedness
1	NN	NN	NN
2	1.5	NN	1.5
3	1.83	2.33	1.67
4	1.83	2.33	2
5	1.83	2.5	2
6	2.17	2.67	2
7	3	3.5	3

Note. “NN” means “not necessary.” Intrinsic motivation is measured on a 7-point scale.

Autonomy, competence, and relatedness are measured on a 5-point scale.

Table 4*Descriptive Statistics, Reliabilities, and Correlations for Study 2*

Variables	M	SD	1	2	3	4	5	6	7
1. Autonomy	3.26	0.72	(.81)						
2. Competence	4.11	0.58	.40**	(.84)					
3. Relatedness	3.43	0.87	.48**	.43**	(.88)				
4. Identified regulation	4.80	1.40	.41**	.32**	.32**	(.90)			
5. Intrinsic motivation	3.99	1.58	.48**	.34**	.41**	.68**	(.95)		
6. Life satisfaction	5.19	1.36	.33**	.23**	.34**	.25**	.36**	-	
7. Vigor	3.88	1.26	.50**	.38**	.41**	.60**	.74**	.46**	(.90)

Note. N = 417. The alpha reliabilities are listed on the diagonal in parentheses.

* $p < .05$

** $p < .01$

Figure 1

NCA Plots in Study 1

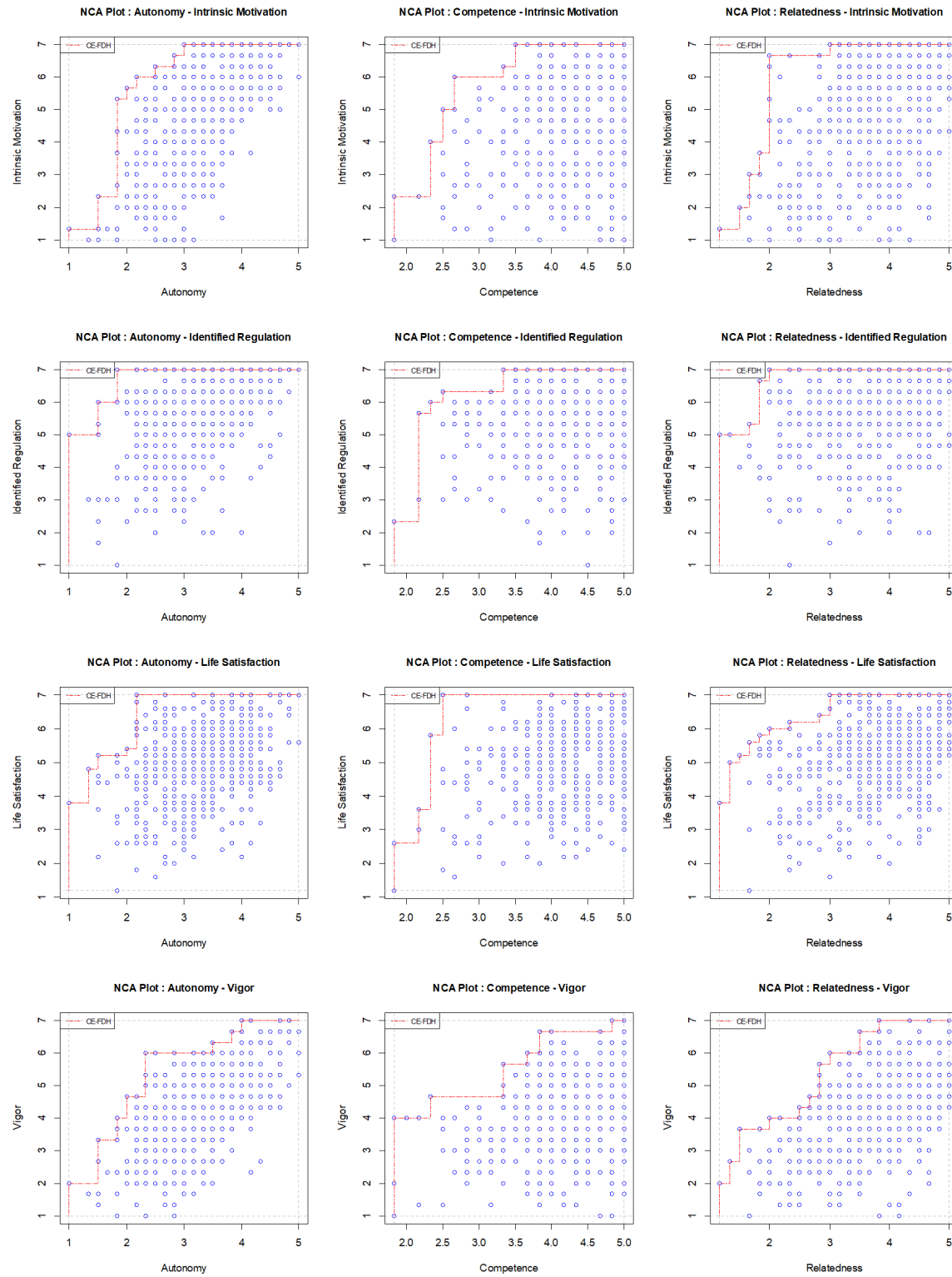
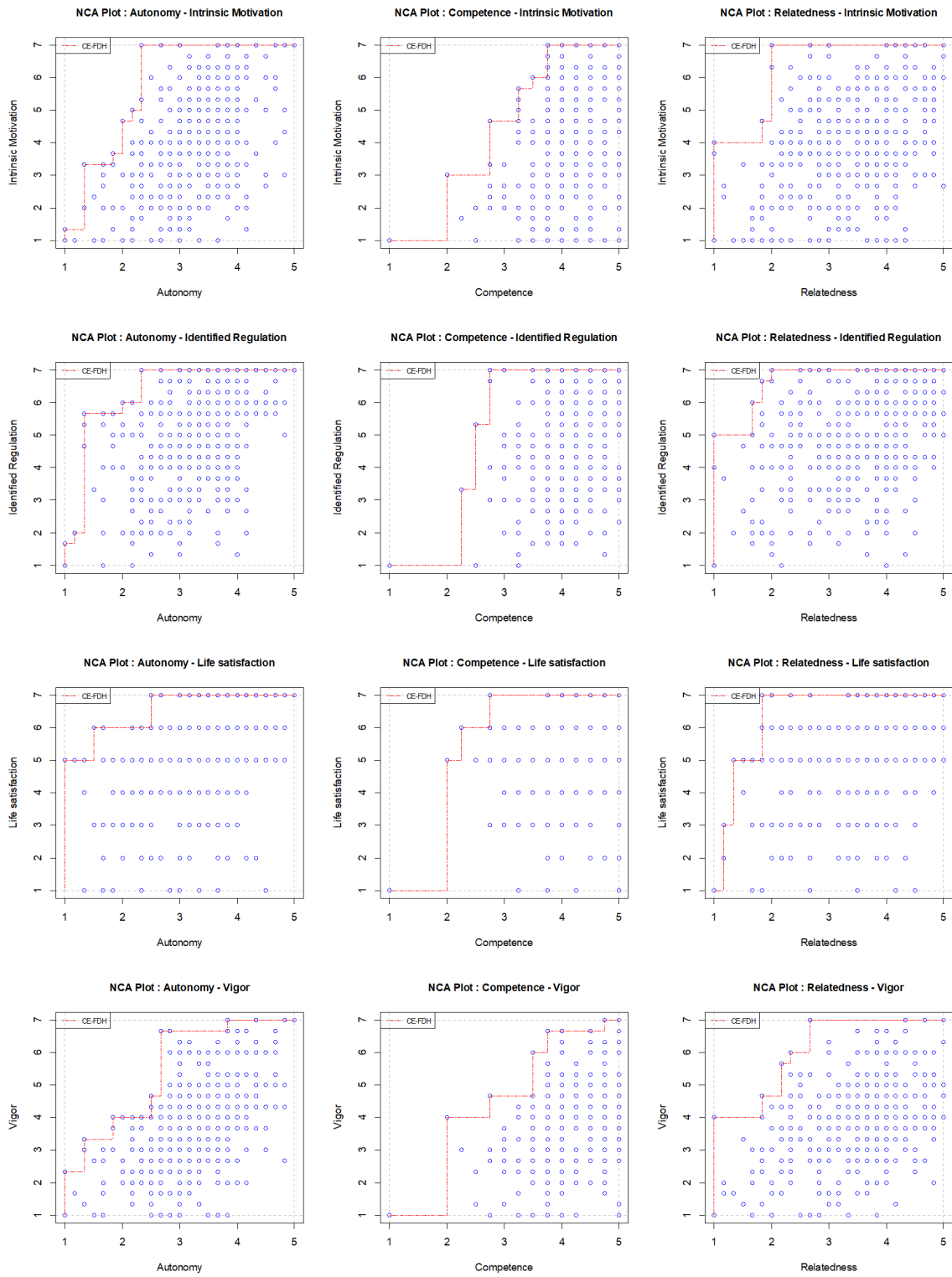


Figure 2

NCA Plots in Study 2



Appendix

Table A1

Bottleneck Table for Identified Regulation in Studies 1 and 2

Identified regulation	Study 1		Study 2		
	Competence	Relatedness	Autonomy	Competence	Relatedness
1	NN	NN	NN	NN	NN
2	NN	NN	1.17	2.25	NN
3	2.17	NN	1.33	2.25	NN
4	2.17	NN	1.33	2.5	NN
5	2.17	NN	1.33	2.5	NN
6	2.33	1.5	2	2.75	1.67
7	3.33	1.83	2.33	2.75	2

Note. “NN” means “not necessary.” Identified regulation was measured on a 7-point scale.

Autonomy and competence were measured on a 5-point scale.

Table A2*Bottleneck Table for Life Satisfaction in Studies 1 and 2*

Life satisfaction	Study 1			Study 2		
	Autonomy	Competence	Relatedness	Autonomy	Competence	Relatedness
1	NN	NN	NN	NN	NN	NN
2	NN	NN	NN	NN	2	1.17
3	NN	2.17	NN	NN	2	1.17
4	1.33	2.33	1.33	NN	2	1.33
5	1.50	2.33	1.33	NN	2	1.33
6	2.17	2.5	2	1.5	2.25	1.83
7	2.17	2.5	3	2.5	2.75	1.83

Note. “NN” means “not necessary.” Life satisfaction was measured on a 7-point scale.

Competence and relatedness were measured on a 5-point scale.

Table A3*Bottleneck Table for Vigor in Studies 1 and 2*

Vigor	Study 1			Study 2		
	Autonomy	Competence	Relatedness	Autonomy	Competence	Relatedness
1	NN	NN	NN	NN	NN	NN
2	NN	NN	NN	NN	2	NN
3	1.5	NN	1.5	1.33	2	NN
4	1.83	NN	2	1.83	2	NN
5	2.33	3.33	2.83	2.67	3.5	2.17
6	2.33	3.67	3	2.67	3.5	2.33
7	4	4.83	3.83	3.83	4.75	2.67

Note. “NN” means “not necessary.” Vigor was measured on a 7-point scale. Autonomy, competence, and relatedness were measured on a 5-point scale.

Table A4*Bottleneck Table for Intrinsic Motivation in Study 2*

Intrinsic motivation	Autonomy	Competence	Relatedness
1	NN	NN	NN
2	1.33	2	NN
3	1.33	2	NN
4	2	2.75	NN
5	2.17	3.25	2
6	2.33	3.5	2
7	2.33	3.75	2

Note. “NN” means “not necessary.” Intrinsic motivation was measured on a 7-point scale.

Autonomy, competence, and relatedness were measured on a 5-point scale.