

Creativity and working from home: a necessary condition analysis

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Abstract

Individual creativity of employees is a key driver of organizational innovation, competitive advantage, and long-term performance and survival. While numerous studies have examined various antecedents that enhance the individual creativity of employees, non have researched whether these antecedents are truly necessary for creativity to occur. This study applies Necessary Condition Analysis (NCA) to investigate whether four commonly cited antecedents – openness to experience, job autonomy, open network and transformational leadership – function as non-compensable prerequisites for high levels of individual creativity. Additionally, this study takes the extent of remote work into account, as this might alter the necessity of the antecedents. An online survey was distributed among employees of a software company and the Public Prosecution Service, resulting in 56 respondents. The findings reveal that perceived job autonomy is the only necessary condition for the entire dataset; without a minimum degree of perceived job autonomy, high levels of individual creativity cannot be achieved. In contrast, other antecedents were not found to be necessary, except for perceived job autonomy when working 0-25% from home, and open network when working 50-75% from home. These results highlight the context-dependent nature of necessity and identify fundamental bottlenecks of individual creativity. Methodologically, this study demonstrates the added value of NCA as an analytical approach, enabling researchers to distinguish between merely supportive and necessary factors

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1. Introduction

Extensive literature considers individual creativity of employees as a key driver for organizational innovation, competitive advantage, long-term performance and survival (Anderson et al., 2014; Soda et al., 2021; Amabile & Pratt, 2016). As such, a lot of research has been conducted regarding the relevant antecedents that enhance individual creativity in the workplace (Oldham & Cummings, 1996; Anderson et al., 2014). Studies have revealed numerous of them, including openness to experience, job autonomy, open network and transformational leadership (Amabile, 1996; George & Zhou, 2001; Liu et al., 2016; Tierney & Farmer, 2002; Gong et al., 2009; Perry-Smith & Mannucci, 2017). The previous mentioned antecedents have been most consistently portrayed in the literature as being of great importance for fostering creativity, which may suggest that they could, to some extent, be necessary for its occurrence (Anderson et al., 2014; Amabile & Pratt, 2016; Gong et al., 2009; Burt, 2004).

However, despite the extensive research highlighting the positive relationship between the four mentioned antecedents on the one hand, and individual creativity on the other hand, a key gap remains: existing literature focuses only on the strengths of the relationships by conducting a correlation or regression-based analysis, without addressing the question whether these antecedents are truly necessary conditions for individual creativity to occur. It remains unclear whether the absence of the specific antecedent would prevent high levels of creativity from occurring at all, or whether some antecedents can compensate for others. While some studies suggest that the antecedents can be partially substituted - e.g. openness might compensate for low autonomy (Raja & Johns, 2010) or contextual factors might compensate for fewer creative personality traits (Madjar et al., 2002) - others point to complementarity - e.g. open networks only enhance creativity when combined with high openness (Baer, 2010). Gottfredson et al. (2025) also highlighted this gap, urging researchers to examine which antecedents of creativity are more important than others, since not all antecedents equally drive creativity. Furthermore, the growing presence of remote and hybrid work – particularly since the COVID-19 pandemic – has significantly altered the nature of workplace

settings (Barrero et al., 2023). Recent research suggests that (increased levels of) working from home might influence how the mentioned antecedents function regarding their relationship with creativity (Leroy et al., 2021; Maurer et al., 2022; Yang et al., 2022). For instance, working from home has been shown to increase job autonomy and decrease the effectiveness of transformational leadership, which might alter the necessity of these antecedents in different working contexts (Yang et al., 2022; Wang et al., 2020, 2021; Galanti et al., 2021; Rietveld et al., 2021). While job autonomy may be a necessary condition for creativity in traditional office settings, its necessity might diminish in remote work environments where autonomy is more inherently present.

Understanding whether these antecedents are truly necessary conditions for creativity to occur is not only theoretically relevant, but also relevant for organizational practice. Organizations invest in initiatives aimed at fostering and facilitating creativity – ranging from the redesigning of jobs to leadership training – without knowing which of the initiatives lead to the support of creativity and which are truly necessary. For this reason, they can't prevent taking the wrong initiatives when aiming to enhance creativity in the workplace. Moreover, the shift to more remote work has altered the relationships between the mentioned antecedents and creativity. The necessity of the antecedents might change depending on the work context. If organizations want high levels of creativity from their employees in all work contexts, they need empirical evidence regarding which antecedents are necessary in which work context. This way, organizations can focus their efforts more strategically and design work environments that ensure the possibility of creativity in any context.

This thesis addresses the research gap by conducting a Necessary Condition Analysis (NCA) (Dul, 2016) to examine which of the mentioned antecedents are necessary for creativity to occur. Unlike traditional methods, NCA does not measure the strengths of effects, but measures whether the chosen variables (antecedents of creativity) are necessary conditions, and to what extent, for creativity to occur. Given the scope and size of this master thesis, this study limits its research to the previous mentioned antecedents: openness to experience, job autonomy, open networks and

transformational leadership, which are consistently linked to enhance individual creativity (Anderson et al., 2014; Amabile & Pratt, 2016; Gong et al., 2009; Burt, 2004). In addition to conducting a general NCA across the full sample, this study also explores whether the necessity of these antecedents differs depending on the work context: fully from the office, mild hybrid, more hybrid and fully remote. To do so, three separate NCAs will be performed for each work context, enabling a context-sensitive understanding of which antecedents are truly necessary in each environment.

This study contributes to the literature on creativity in organizations in three ways. First, it advances theoretical understanding by applying a necessity perspective, showing that job autonomy is not merely a strong predictor, but a structural bottleneck – without it, high levels of individual creativity can't be reached. In doing so, this study answers a recent call from the literature to explore which antecedents of creativity are more important than others (Gottfredson et al., 2025). Second, by showing that the other antecedents are not necessary conditions, this study adds – just like the first contribution – to the extensive literature regarding individual creativity and its predictors (Anderson et al., 2014; Amabile & Pratt, 2016; Gong et al., 2009; Burt, 2004). This highlights the role of these antecedents as merely supportive rather than necessary. It contributes to a more refined understanding of how these antecedents function in practice and invites scholars to distinguish more clearly between supporting and necessary predictors. Third, this study deepens theoretical insights by showing that the necessity of the antecedents can shift dependent on the working context. Job autonomy shows to be a necessary condition when working mostly from the office, and open networks become necessary in more hybrid work environments. These findings nuance existing models of creativity by showing that the necessity is not absolute but shaped by work context. Furthermore, it adds to the literature regarding the impact of working from home on creativity (Yang et al., 2022; Wang et al., 2020, 2021; Galanti et al., 2021). Together, these contributions integrate necessity logic in the creativity research field and lay the groundwork for a more prioritized and context-dependent understanding of the antecedents of individual creativity.

2. Literature review

2.1 Creativity in the workplace

Innovation in organizations is usually divided into distinct phases: idea generation and implementation (Burt, 2004; Carnabuci & Diószegi 2015; Perry-Smith & Mannucci, 2017; Mannucci & Perry-Smith, 2022). The first one is in literature regarded as creativity – the generation of novel and useful ideas - while innovation includes the later phase of implementation – converting the idea into an actual innovation (Amabile, 1996; Oldham & Cummings, 1996; Anderson et al., 2014; Mannucci & Perry-Smith, 2022; Kijkuit & Van Den Ende, 2007; Carnabuci & Diószegi 2015). This study focuses solely on the idea generation part of the innovation process. Individual employee creativity is widely regarded as a critical driver for organizational innovation, competitive advantage, and long-term performance and survival (Anderson et al., 2014; Soda et al., 2021; Amabile & Pratt, 2016). Employees' creative thinking serves as an essential source of novel ideas and plays a key-role in bottom up innovation within organizations (Burgelman, 1983; Cheng & Van de Ven, 1996; Perry-Smith & Mannucci, 2017), contributing to positive outcomes such as success, financial gain and competitive advantage (Woodman et al., 1993; Anderson et al., 2014; Zhou & Hoever, 2014; Ouakouak & Ouedraogo, 2017). Therefore, supporting and sustaining employees' creativity is crucial for organizations.

A large stream of research has explored the antecedents of employee creativity, leading to the identification of numerous contributing factors (see for an overview for instance Anderson et al., 2014; Zhou et al., 2014; Sapiyi et al., 2022; Sidelkivska & Bilbao-Calabuig, 2023; Gottfredson et al., 2025). Anderson et al. (2014) offers a comprehensive framework that categorizes these antecedents across four levels of analysis: individual, team, organizational and multilevel. Within the individual level, Anderson et al. (2014) further differentiates between individual factors, task contexts and social contexts. Among these subcategories, four antecedents have been particularly well-researched and, in general, consistently linked to enhance creativity: openness to experience (individual factor),

job autonomy (task context), open network (social context) and transformational leadership (social context).

Despite this large stream of research focusing on the antecedents of creativity, one key question largely remains unanswered: which of the antecedents are truly necessary conditions for individual creativity to occur? Although these antecedents are often described as crucial or of great importance, it remains unknown whether their absence would truly prevent creativity from emerging. In other words, which antecedents represent the 'need-to-haves', rather than the 'nice-to-haves'? All the existing research focuses on the strength of the (positive) relationships between the antecedents and creativity by performing correlational or regression-based methods. However, these approaches don't address which antecedents are truly necessary and whether the absence of a certain antecedent would prevent creativity from occurring. Gottfredson et al. (2025) voiced a similar concern, noting that while literature has established numerous antecedents as important, it lacks a clear understanding of which antecedents matter most and are more important than others. This gap highlights the need for a necessity-based approach to investigate which of the antecedents are necessary conditions for employees' creativity to occur in organizational settings.

Furthermore, due to COVID-19, many organizations shifted to more remote work, and this trend continued even after the pandemic, leading to lasting changes in work environments (Barrero et al., 2023). This shift led to fundamental changes in the way employees interact and collaborate, reducing spontaneous interactions, weakening network diversity and social capital (Shockley et al., 2021; Maurer, Bach, & Oertel, 2022; Yang et al., 2022). It leads to more static and siloed teams, less exposure to diverse ideas, brings challenges regarding leadership and increases interruptions during worktime (Yang et al., 2021; Gibbs et al., 2024; Deepa et al., 2023; Barrero et al., 2023; Leroy et al., 2021). Some studies raise concerns about the question whether working from home may hinder innovation capabilities and the early-stage generation of ideas (Brucks & Levav, 2022; Lin et al., 2023). These contextual changes might influence how the antecedents of creativity unfold,

potentially changing their importance and necessity. Therefore, the necessity of the antecedents will also be examined depending on the level of working remotely.

2.2 Key antecedents of employee creativity

2.2.1 Openness to experience

Openness to experience, which belongs to the Big Five personality traits, reflects the extent to which an individual is imaginative, intellectually curious, open to ambiguity, broad-minded and receptive to novel ideas and experiences (McCrae, 1987; Costa & McCrae, 1992). Persons high in openness to experience are more inventive and interested in exploring new unfamiliar and unconventional experiences and perspectives, which allows them to access a wider range of cognitive perspectives (Costa & McCrae, 1992; McCrae, 1996; McCrae & Costa, 1997). In organizations, these individuals are more able to generate novel ideas that question or go beyond the status quo (George & Zhou, 2001). Furthermore, individuals high in openness to experience also have high cognitive flexibility, which makes it next to a fundamental personality trait, a valuable psychological resource (Feist, 2018; Sidelkivska & Bilbao-Calabuig, 2023).

A substantial body of research identifies openness to experience as one of the strongest and most reliable predictors of individual creativity (see for an overview of studies Sidelkivska & Bilbao-Calabuig, 2023; Tidikis & Dunbar, 2019; Xu et al., 2018; Petrou et al., 2023; Tan et al., 2019).

Individuals high in openness to experience are more inclined to think divergently, consider unfamiliar perspectives and integrate diverse knowledge, which are all essential to the generation of novel ideas, thus enhancing creativity (McCrae, 1987; Xu et al., 2018). Petrou et al. (2023) show in their study that openness to experience is positively related to both incremental and radical innovation, with a particularly strong relation to radical innovation, since it has an inherently exploratory nature. Furthermore, openness to experience enhances intrinsic motivation, which in turn fosters creativity (Tan et al., 2019). As such, openness to experience is widely regarded as a key antecedent of employee creativity.

Working from home is not expected to directly influence the individual's level of openness to experience, since personality traits are a relatively consistent set of cognitive and behavioral characteristics (Tan et al., 2019). Since this trait is deeply rooted within a person itself, it is unlikely to fluctuate based on changes in work contexts. Work contexts might influence the way in which individuals express their openness, but it doesn't impact the level of openness to experience.

The necessity of openness to experience can be justified through causal mechanisms, as proposed by Dul (2021). Three 'why' questions need answering for this:

1. Why if X (openness to experience) is absent also Y (creativity) is absent?
2. Why if Y (creativity) is present also (openness to experience) is present?
3. Why the absence of X (openness to experience) cannot be compensated by another concept?

Without openness to experience an employee is less likely to think divergently, nor can the individual explore unfamiliar perspectives, making him unlikely to generate new and useful ideas (McCrae, 1987; Xu et al., 2018) (1). Conversely, empirical research shows that individuals that score high on creativity are (in general) also high in openness to experience (e.g. Sidelkivska & Bilbao-Calabuig, 2023; Tidikis & Dunbar, 2019; Xu et al., 2018). This suggests that when (high levels of) creativity are observed, it is typically accompanied by a high level of openness (2). Finally, the absence of openness to experience isn't easily substitutable by other factors, since other factors can't make up for a complete lack of curiosity or willingness to engage with novelty, it predicts both the desire to engage and the cognitive ability to generate creative outcomes (Silvia et al., 2014; Grosul & Feist, 2013), and it's a core personality trait rooted in somebody (McCrae, 1987; Costa & McCrae, 1992) (3). Based on the literature we expect that a high level of openness to experience is a necessary condition in general and in every specific work context. Therefore:

Hypothesis 1: a high level of openness to experience is a necessary but not sufficient condition for high levels of individual creativity to occur in general and regardless of work location

2.2.2 Perceived job autonomy

Job autonomy refers to the degree of control employees have over their own work, the extent to which they can make independent decisions without external interference, and the extent to which they can decide how and when to perform their work-related tasks (Acar et al., 2018; Hackman & Oldham 1976; Morgeson & Humphrey, 2006). An extensive body of literature shows that having (high levels of) job autonomy in general has a positive effect on creativity (e.g. Amabile & Pratt, 2016; Gagné & Deci, 2005; Liu et al., 2016; Ohly & Fritz, 2010; Bledow et al., 2021). A higher level of job autonomy leads to an increase in motivation (Langfred & Moya 2004; Liu et al., 2016), felt responsibility and ownership at work (Parker et al., 1997; Hackman & Oldham 1976), incremental learning (Daniels et al., 2009) as well as an employee's confidence in their ability to drive change in the workplace (Axtell et al., 2000), which in turn might lead to higher levels of individual creativity. Next to this, research shows that employees with a higher job autonomy are more inclined to think creatively, engage in problem-solving and to take risks (Oldham & Cummings 1996; Tierney & Farmer 2002). All the previous mechanisms are expected to foster and facilitate individual creativity of employees.

Based on the above, job autonomy seems to be a necessary condition for employee creativity across all work contexts. It seems unlikely that employees without a minimal degree of job autonomy show high levels of creativity, since they have no space to experiment, explore, take initiative, or deviate from prescribed routines, which are key conditions for creativity (Tierney & Farmer, 2002; Hackman & Oldham, 1976). For the same reason, the absence of job autonomy leads to the absence of individual creativity, and vice versa in the sense that when creativity is present, job autonomy has to be present as well. Furthermore, research indicates a clear positive relationship between the two variables; when researched, a high level of job autonomy leads (in general) to (a) high(er) level(s) of creativity. Lastly, job autonomy can't easily be compensated by other factors, since solely job autonomy offers the individual the behavioral freedom necessary to act on creative potential, making it a non-compensable condition (Dul, 2016, 2021).

Research shows that working from home generally enhances employees' perceived job autonomy, since remote working offers employees more control over when, where and how they perform their tasks (Gajendran & Harrison, 2007; Wang et al., 2020), partly due to physical distance from managerial oversight (Wang et al., 2020, 2021; Galanti et al., 2021; Rietveld et al., 2021; Brunelle & Fortin, 2021). This might mean that the threshold of the necessary amount of job autonomy might be more easily met, however, the necessity of it likely persists across all work contexts. Thus:

Hypothesis 2: a high level of perceived job autonomy is a necessary but not sufficient condition for high levels of employee creativity to occur in general and regardless of work location

2.2.3 Open network

Open networks, often referred to as brokering networks, networks rich in structural holes or having weak ties, are characterized by connections between otherwise unconnected contacts (Burt, 1992; Burt, 2004; Aral & Van Alstyne, 2011). By being connected to otherwise unconnected contacts, individuals are exposed to more diverse views, ideas and heterogenous information (Iorio, 2022), giving them access to non-redundant information. By occupying this brokering position in an open network, individuals can access, and control diverse sources of information found in the network (Soda et al., 2019). In contrast, closed networks are made up of highly interconnected individuals, facilitating trust and cohesion formation (Iorio, 2022). However, the flipside of having a closed network is only having access to more similar information that the members of the network hold, which leads to redundancy of the information flow (Rogan & Mors, 2014).

There is extensive literature suggesting that open networks are particularly effective in fostering creativity, while closed networks are better for idea implementation (Kijkuit & Van Den Ende, 2007; Aral & Van Alstyne, 2011; Burt, 2004; Obstfeld, 2005; Carnabuci & Diószegi 2015; Perry-Smith & Mannucci, 2017; Mannucci & Perry-Smith, 2022). The reason for this is that open network provide access to diverse and non-redundant information, which is essential for creativity and the generation of ideas, whereas closed networks offer trust and mutual understanding for effectively

implementing the ideas (Carnabuci & Diószegi 2015; Miron-Spektor et al., 2011). Individuals in open networks are provided with diverse views, ideas and heterogeneous information, and are more likely to combine seemingly unrelated ideas, boosting the idea generation process and thus leading to more innovation (Granovetter, 1973; Burt, 1992; Burt, 2004; Aral & Van Alstyne, 2011; Carnabuci & Diószegi 2015). A study by Breet (2022) shows that having an open network is a necessary condition for attaining high levels of individual innovation.

It is unlikely that high levels of creativity occur in the absence of an open network, because these networks provide access to diverse non-redundant information and novel perspectives that are crucial for generating new ideas (Burt, 2004; Aral & Van Alstyne, 2011; Perry-Smith & Mannucci, 2017). Creative individuals are therefore often found in open network positions, which has been empirically demonstrated by Breet's (2022) study; his study shows that individuals cannot achieve high levels of individual innovation without having an open network. Therefore, when creativity is present, it is often accompanied by some degree of informational diversity or external stimulus – typically accessed by open networks. While other factors such as job autonomy or openness to experience also enable creativity, they do not substitute for the diverse views and heterogeneous information that open networks provide. Thus, the absence of an open network can't be easily compensated for by other factors.

Remote work disrupts open networks by reducing the formation of weak ties and the frequency of informal interactions, thereby limiting access to diverse and non-redundant information (Maurer et al., 2022; Granovetter, 1973; Yang et al., 2022; Deepa et al., 2023). This makes it harder for employees to have open networks and to profit from the positive consequences it provides for their creativity. The reduced viability of open networks might reduce their necessity for achieving high levels of individual creativity. Instead, other antecedents in a remote working environment – like job autonomy and thereby intrinsic motivation, which are strong predictors of creativity – might compensate for this, along with focused time and reduced workplace distraction. Thus:

Hypothesis 3a: an open network position is a necessary but not sufficient condition for high levels of employee creativity in general

Hypothesis 3b: an open network position is a necessary but not sufficient condition for high levels of employee creativity, when working hybrid or completely from the office

Hypothesis 3c: an open network position is not a necessary condition for high levels of employee creativity, when working completely from home

2.2.4 Perceived transformational leadership

Bass (1985) has defined the transformational leadership style by four dimensions: intellectual stimulation (encouraging followers to question assumptions, rethink problems, and explore creative and unconventional solutions), charisma or idealized influence (serving as follower's charismatic role model), inspirational motivation (inspiring followers through a compelling vision) and individualized consideration (focusing on followers' development by showing empathy, recognizing their needs, and supporting their ideas and initiatives (Bass, 1985). A leader with this style seeks to inspire, motivate and develop followers by transforming or changing their beliefs, values and attitudes, resulting in a greater willingness among employees to exceed the basic organizational expectations (Podsakoff et al., 1990).

Almost all research conducted in this area indicates that transformational leadership is the most important leadership style in enhancing employees' creativity (Jung et al., 2003; Tierney, 2008; Gong et al., 2009; Anderson et al., 2014; Kaya, 2024). Through the intellectual stimulation of transformational leaders, transformational leaders stimulate innovative thinking by encouraging employees to question the status quo, explore creative solutions and new ideas, and take intellectual risks (Jung et al., 2003; Gumusluoglu & Ilsev, 2009). This is particularly effective, since these leadership behaviors enhance intrinsic motivation and (creative) self-efficacy, which in turn might lead to increased individual creativity (Amabile, 1996; Tierney et al., 1999; Shin & Zhou, 2003; Gumusluoglu & Ilsev, 2009; Gong et al., 2009). Transformational leaders create a supportive environment for employees through individualized consideration, reducing the fear of failure and

fostering an openness to novelty and exploration (Gong et al., 2009). They serve as creative role models and since transformational leaders are charismatic and inspirational, employees are likely to learn from such leaders (Gong et al., 2009). Lastly, Khalili (2016) concludes that this leadership style is of significant importance for creativity in the workplace.

From a necessity logic perspective, transformational leadership seems to be a necessary condition for high levels of creativity. In its absence, employees lack intellectual stimulation, support and vision to generate useful ideas (Jung et al., 2003; Podsakoff et al., 1990; Bass & Avolio, 1994). Without the presence of this leadership style, employees may be less intrinsically motivated or hesitate to take intellectual risks (Gumusluoglu & Ilsev, 2009). Furthermore, literature clearly paints a positive picture regarding the relationship between the two. Transformational leadership is essential for creativity in the workplace (Khalili, 2016), thus it's likely to be present when individuals demonstrate high levels of individual creativity.

Studies investigating the effect of working from home on (the effectiveness of) transformational leadership present mixed findings (Tautz et al., 2022). Several researchers argue that working from home hinders important elements of transformational leadership due to reduced social presence, fewer informal interactions, absence of body language, geographical distance and technological and communication challenges (Eisenberg et al., 2019; Liebermann et al., 2021; Tautz et al., 2022; McAlpin, 2018; Kirchner et al., 2021; Wang et al., 2020). However, other studies have provided a more optimistic view (e.g. Kelloway et al., 2003; Neufeld et al., 2010; Purvanova and Bono, 2009; Hüttemann et al., 2025). Purvanova and Bono (2009) argued that transformational leaders might compensate for distance by putting more effort into their leadership behavior. Remarkable is the fact that these articles are quite dated. Remote work has become 'booming' particularly in the last few years. Thus, this study assumes that transformational leadership is less effective in remote work settings. As a result, the necessity of transformational leadership seems not as evident in fully remote working contexts. At the same time, other factors – like job autonomy –

are enhanced, which may act as compensating mechanisms through which individuals can achieve high levels of creativity even in the absence of effective transformational leadership. Thus:

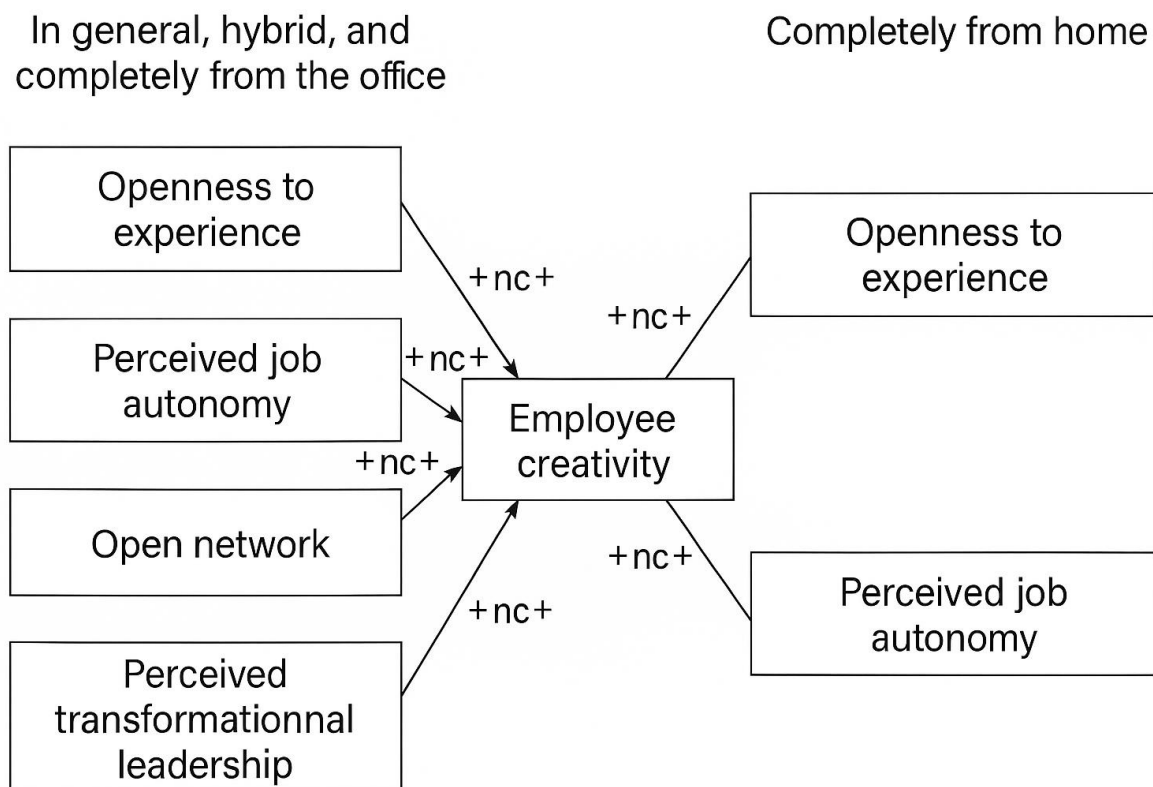
Hypothesis 4a: a high level of perceived transformational leadership style is a necessary but not sufficient condition for high levels of employee creativity in general

Hypothesis 4b: a high level of perceived transformational leadership style is a necessary but not sufficient condition for high levels of employee creativity, when working hybrid or completely from the office

Hypothesis 4c: a high level of perceived transformational leadership style is not a necessary condition for employee creativity, when working completely from home

Figure 2-1

Conceptual model



3. Methodology

3.1 Research Setting & Data Collection

The data required for the necessary condition analysis has been collected by means of an online survey. This survey was distributed at two organizations: the Public Prosecution Service Midden-Nederland and VAA Data Works in Rosmalen. We received a total of 66 responses from both the Public Prosecution Service Midden-Nederland and VAA Data Works. The survey was shared through e-mail, with one reminder being sent in the group chat of 200 people of the Public Prosecution Service. VAA has a total of 40 employees and 17 of them completed the survey, leading to a response rate of 42.5%. At the Public Prosecution Service 45 people participated, of whom 39 completed it, leading to a response rate of respectively 22.5% and 19.5%. Of four respondents it remained unclear which organization they worked for, since they barely filled in any question. Therefore, the missing data is 10 and the final sample (n) consists of 56 respondents. According to Hair et al. (2019) this sample size is large enough for a (factor) analysis, since samples should consist of at least 50 observations, or have a ratio of five or preferably ten observations to variables. Next to this, NCA requires a minimum of four cases to calculate statistical significance (p-value) using permutation testing (Dul, 2021). The sample in this study therefore meets all requirements.

The two organizations at which the survey was set out provide an appropriate research setting for testing the hypotheses and ultimately answering the research questions. Both organizations have knowledge-intensive work environments, where creativity and the other variables play a central role in the day-to-day functioning. At both organizations, working from home has become standard, which is effective for this study. Furthermore, creativity is important in both organizations; VAA is a technology firm where innovation is key, and at the Public Prosecution Service, considerable attention is also given to exploring new and more efficient ways of working, with the goal of handling criminal cases and investigations more quickly and efficiently.

3.2 Measurements

The scales used in this thesis are all pre-existing scales, which all have been used, tested, validated and evaluated. Before conducting the NCA, firstly, monotone responses were checked to identify potential response biases, but none were found. Next, basic descriptives were examined to gain an initial understanding of the data and to detect potential outliers, as these can significantly influence NCA outcomes (Dul, 2021). Subsequently, the internal consistency reliability of each multi-item construct was assessed using Cronbach's alpha, which indicates how well the items within a scale correlate and reflect a shared underlying concept. A threshold of 0.70 is generally considered acceptable for reliability (Hair et al., 2019), although 0.60 is often deemed sufficient in exploratory research. Following this, factor analyses were performed to evaluate construct validity by examining whether items cluster as theoretically expected. To check whether the data was suitable for factor analysis two tests were conducted: the Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy and Bartlett's test of sphericity. The KMO-value must be 0.50 or bigger and the Bartlett's test should be significant in order for the data to be suitable for factor analysis (Hair et al., 2019). Based on the results of these analyses, items were retained or removed to optimize the reliability and validity of each construct.

Individual Creativity. To measure the dependent variable, we used the items of Dul et al. (2011), which have a focus on idea generation and creativity, and not on the later stages of innovation (Table A1). This is a self-perceived creativity measure, as employees themselves are most capable of reporting their creativity (Zhou, Shin, & Cannella, 2008). The three items of Dul et al. (2011) are based on George and Zhou's (2001) 13-item scale for supervisor rating of employee creativity. The three items can be answered by a seven-point Likert scale, with 1 being very inaccurate and 7 being very accurate. The items reflect a self-perceived measure of creativity, indicating the extent to which participants believe they generate new and potentially useful ideas (Zhou, Shin, & Cannella, 2008). Descriptive statistics, reliability (Cronbach's alpha) and construct

validity (factor analysis) were checked to assess the measurement quality of the creativity scale; all items were retained. For the full analysis, see Appendix A.

Open network. To measure network openness, the inverse of Burt's (1992) constraint measure is commonly used in literature. However, applying this method was not feasible given the scope and time given for this thesis. For this reason, four items were selected from the 'separation brokerage' orientation scale developed by Grosser et al. (2018), which captures behavioral tendencies associated with maintaining separation among one's work contacts (i.e. tertius gaudens orientation). Next to the four items, an additional item was added to the questionnaire: 'I often hear different perspectives because my work contacts come from diverse circles' (Table B1). This way the perceived diversity of information from non-redundant ties is better reflected. Together, these five items measure the level of (self-perceived) open network. After checking the descriptive statistics and conducting a reliability (Cronbach's alpha) and validity (factor analysis) test, two out of five items were deleted from the NCA. See Appendix B for the full analysis.

Openness to experience. This personality trait was measured using the shortened version of the International Personality Item Pool of Goldberg (1999) for openness to experience (Donnellan et al., 2006) (Table C1). Donnellan et al. (2006) made a shorter version, noticing that participants sometimes don't have a lot of time to fill in all the questions/statements. With this version, there are just four items, instead of many more. Participants can answer the question through a 5-point Likert scale, ranging from 1 (strongly disagree) to 5 (strongly agree). After checking the descriptive statistics and performing reliability (Cronbach's alpha) and validity (factor analysis) tests, one of the items was excluded from further analyses. See Appendix C for the full analysis.

Perceived job autonomy. Perceived job autonomy is measured by the three-item scale of Hackman & Oldham (1975) (Table D1). Participants answer on a 7-point Likert scale, ranging from 1 (very little/inaccurate) to 7 (very much/accurate). Descriptive statistics were checked, and reliability (Cronbach's alpha) and validity (factor analysis) tests were conducted, which lead to the retention of all three items. See Appendix D for the full analysis.

Perceived transformational leadership. Perceived transformational leadership serves as an independent variable in this research. The seven-item Global Transformational Leadership Scale (GLT) from Carless et al. (2000) has been used to measure the level of perceived transformational leadership (Table E1). It has been shown that the scale has a high internal consistency (Carless et al., 2000). The GLT scale is made up of seven components and the response format ranges from 1 (strongly disagree) to 7 (strongly agree). Through these questions, respondents rate to which extent their leader shows behaviors of transformational leadership. All seven items were included in the NCA, after checking the descriptive statistics and Cronbach's alpha, and conducting a factor analysis. See Appendix E for the full analysis.

Working from home. The extent of working from home is measured as the percentage of an employee's weekly working hours spent working remotely, relative to their total weekly working hours. The participant is asked to fill in the percentage on a metrical scale of 0-100, with 0 indicating that the participant works only from the office and 100 indicating that the participant works only from home. This study considers 0-25% as working entirely from the office, 25-50% as mild hybrid, 50-75% as more hybrid and 75-100% as completely from home. Unfortunately, the highest score on this measure was 60%, which means the last group can't be analyzed.

Control variables. In normal regression analysis, control variables are incorporated into the analysis to isolate the unique relationship between the independent variable(s) and the dependent variable as much as possible and reducing omitted variable bias, by accounting for the influence of other variables that might affect this relationship (Carlson & Wu, 2012). In NCA, control variables don't play a role, since NCA operates in complete isolation from the other variables (Dul, 2021) and it only concerns itself with the condition and outcome, isolated from all other variables (in the model). The ceiling line is drawn on top of the observations, given solely the maximum levels of the outcome (Y) given the specific values of the condition (X). Therefore, control variables don't play a role in NCA and won't be incorporated.

Mean construct variables. To conduct the NCA, it is essential to work with aggregated construct scores rather than individual scores for each item. Therefore, composite variables are needed that represent each theoretical construct in a single score, which is normally calculated as the mean of the validated items within that construct. For instance, the average for creativity for one respondent will be the sum of the scores on the creativity items divided by the number of items. These mean scores were computed for each of the five constructs. These aggregated variables form the basis for the NCA (Table F1).

3.3 Analytical approach

Necessary condition analysis. This thesis conducts an NCA (Dul, 2016, 2021) to identify which of the factors are essential for employee creativity to occur. Four NCA for each of the constructs will be conducted: one in general for the entire dataset, and three depending on the different work contexts (completely from home, mild hybrid and more hybrid). NCA allows for the identification of the antecedents that must be present for an outcome to be possible, instead of analyzing whether an impact on the antecedent (on average) has an impact on the outcome variable like regression-based analyses such as OLS or ordinal logit models measure (Dul, 2016, 2021). Furthermore, when choosing a regression-based approach, the measurement type of the dependent variable is of interest. This is not the case with NCA, since it doesn't rely on measurement type or distributional assumptions of the outcome variable, meaning that the ordinal dependent variable in this study (individual creativity) can be analyzed by means of NCA and remains methodologically robust (Dul, 2016, 2021). NCA allows us to measure both necessity *in kind* (whether the condition is necessary) and *in degree* (which specific level of the condition is necessary for the specific level of the outcome).

In the context of creativity, NCA is particularly valuable, as it shifts the question from what *enhances* creativity to what is *required* for creativity to emerge at all and to what extent. Given the multitude of antecedents identified in the literature, NCA provides a novel and complementary lens to assess which factors represent critical 'bottlenecks' for creativity and whether creativity can occur in the absence of the condition. A variable can have little predictive power in a regression model yet

be a necessary condition in the sense that without it, the outcome won't reach high levels.

Furthermore, although interaction terms in regression analyses can model the combined effects of variables, they can't capture the non-compensatory logic that the necessity-logic relies on. These models can't address the question whether high levels of creativity occur without the presence of a specific condition.

Therefore, other analytical techniques don't fit with this study, since it focuses on the average strength of relationships between variables. Next to this, NCA is more suited than other set-theoretic approaches, like Qualitative Comparative Analysis, because these kinds of analyses can only analyze the in kind necessity relationships and not the in degree necessity relationships. It's more valuable to also test the latter, since it allows us to determine which specific levels of the predictors are necessary for the outcome.

Ceiling techniques. In NCA ceiling techniques are used to determine whether a variable acts as a necessary condition for a specific outcome (Dul, 2016). This process starts with a scatterplot in which the horizontal X-axis displays the necessary condition and the vertical Y-axis the outcome. When an empty zone appears on the upper left corner, where high values of Y are not paired with low values of X, the scatterplot indicates the necessity of X for Y to occur. For instance, if job autonomy is a necessary condition for high creativity, the upper-left corner of the plot would remain empty, since low levels of job autonomy (the X-axis) don't reach high levels of creativity (the Y-axis). Therefore, low levels of job autonomy constrain higher levels of creativity. However, we might detect points on the lower right corner (high job autonomy and low levels of creativity), since the condition is necessary, but not automatically sufficient for high levels of creativity to occur.

After the observations are plotted, a *ceiling line* can then be drawn to separate the empty zone from the area containing the observations. Two main techniques exist for constructing the ceiling line: Ceiling Envelopment (CE) and Ceiling Regression (CR). CE creates a piecewise linear boundary along the upper left corner of the scatterplot by incrementally connecting the highest value of Y to the increasing levels of X. This technique, used with free disposal hull (CE-FDH) is a

flexible technique (Tulkens, 1993), since it doesn't require many assumptions about the ceiling line and is applicable to dichotomous, discrete and continuous necessary conditions. Because of this, CE-FDH is a default ceiling envelopment technique for NCA. However, this method is more sensitive to outliers, since this technique ensures that there are no observations above the ceiling line. Next to CE, CR-FDH (which is based on the outcomes of CE-FDH) smooths the boundary made by CE-FDH into a single straight line by applying linear regression to the key points of the envelope (Dul, 2016). Therefore, some observations might fall above this straight line. This technique is suitable when both the necessary condition and the outcome are measured on continuous scales. Depending on the accuracy of the representation of the straight ceiling line, one of the two techniques is preferred. Also, CE-FDH is preferred especially suitable for dichotomous and discrete variables and small datasets. The *accuracy* of a ceiling line is calculated by dividing the number of observations that lie on or below the ceiling line by the total number of observations and then multiplying it by 100%. Therefore, the accuracy of CE-FDH is 100%, whereas CR-FDH is most likely below 100%.

Since all the variables used in this study are either discrete or continuous – only open network is continuous – both ceiling line techniques are used. This ensures robustness and provides a comprehensive interpretation of the results.

Effect size. The effects size represents how strongly a condition constrains the outcome (Dul, 2016). It determines whether the necessary condition has a meaningful impact and should be considered. The effect size is calculated by the formula $d = C/S$, where d is the effect size, C is the size of the ceiling zone (the empty zone in the upper left corner) and S is the scope (size of the entire area that can have observations). The outcome indicates to what degree the necessary condition constrains the outcome. Dul (2016) gives a general rule of thumb for the effect sizes: values < 0.1 are considered small effects, > 0.1 and < 0.3 medium, > 0.3 and < 0.5 large and > 0.5 very large.

Permutation test. Furthermore, a permutation test will be performed when conducting an NCA. The permutation test assesses whether the empty space in the upper left corner of the scatterplot could have occurred by chance, which means that there would be no relationship between the condition

and the outcome (Dul, 2016; Dul, Van der Laan, et al., 2020). It tests the null hypothesis that the condition and the outcome are unrelated by shuffling the data and recalculating the effect size numerous times. A high p-value (> 0.05) indicates that the empty space in the upper left corner exists due to chance. The permutation test is automatically integrated into the NCA-software (Dul, 2018; Dul, Van der Laan, et al., 2020).

Bottleneck table. The bottleneck table is a tabular representation of the ceiling line, showing the minimum levels of the conditions that are necessary to achieve specific levels of the outcomes (Dul, 2016, 2021). This table shows the necessity *in degree* by identifying the threshold values of the conditions.

3.4 Research ethics

Throughout the research process, ethical considerations have been seriously considered to ensure the protection, privacy and well-being of participants. Prior to participation, participants were informed about the purpose of this study, the nature of the topic and how the findings would be used. Participation is entirely voluntary, and participants are informed that they can withdraw from the study at any point in time – before, during and after filling in the survey – without providing any reasons. Informed consent was obtained through this, with explaining the details at the beginning of the survey. Furthermore, measures were taken to ensure confidentiality. All collected data will be securely stored, and all participants will be anonymized during the analysis and in the final thesis. There will be no sharing or publishing of any personal data, nor will there be data that can be traced back to any specific individual. With this, a safe and trustworthy environment is created for participants to fill in the survey.

4. Data analysis

An NCA was conducted for each of the different conditions with creativity as the outcome, using the mean construct scores. In some cases, outliers were removed to check whether their influence made the permutation test of the NCA insignificant. The number of permutations was set to 100.000 for each NCA. Furthermore, after conducting a general NCA for the construct with all of the respondents, three separate NCA's were performed, depending on the level of working from home. Working from home was categorized into three groups: 0-25% with 23 respondents, 25-50% with 21 respondents and 50 to 75% with 12 respondents.

Open network. The permutation test of the general NCA of creativity (outcome) and open network (condition) was not-significant (Table G1). Respondents 55 and 4 were removed because of their significant influence, but subsequent analyses did not yield a significant result (Tables G2-G5). This leads to the conclusion that an open network is not a necessary condition for a high level of creativity for the entire dataset.

0-25% and 25-50% working from home. The NCA of the first group (0-25%) lead to an insignificant result, even after removing one influential outlier (Table G6-G8). The NCA of the second group (25-50%) didn't have an effect size and a p-value of 1 (Table G9 and Figure G1). Therefore, having an open network is not a necessary condition for these two groups.

50-75% working from home. The NCA of this group showed that an open network is a necessary condition for high levels of individual creativity. The permutation test turned out to be significant ($p < 0.05$) and the effect sizes (.370 for CE-FDH and .271 for CR-FDH) can be considered as respectively large and medium (Table 4-1) (Dul, 2021).

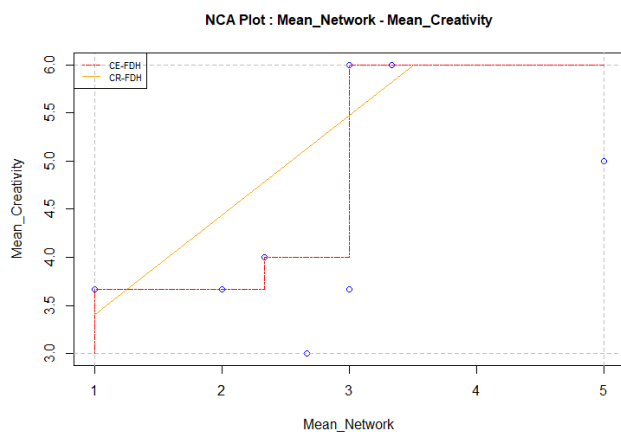
Table 4-1 Results of the NCA

	CE-FDH	CR-FDH
Ceiling zone	4.444	3.252

Effect size	0.370	0.271
# above	0	4
c-accuracy	100%	66.7%
Fit	100%	73.2%
p-value	0.019	0.021
p-accuracy	0.000	0.000

The plot shows a large empty space in the upper left corner (Figure 4-1). This result means that not having an open network constrains achieving high levels of creativity.

Figure 4-1 Plot ceiling lines representing the necessity relationship between open network and individual creativity



According to the bottleneck table (Table 4-2), the CR-FDH method indicates that to reach 80% of the maximum possible level of creativity (which is a score of 5.6 on the Likert scale), a score of at least 48.2% on open network is needed. To reach 90% this increases to 55.4% and to the maximum possible level of creativity (100%) a score of at least 62.6% on open network is required. The CE-FDH

results support this in a stepwise manner, but these results are more conservative. Onwards from a 40% score of creativity to 100%, a score of at least 50% on open network is needed.

Table 4-2 Bottleneck table listing the levels of open network necessary to achieve specific levels of individual creativity

Creativity (%)	Mean_Network (CE-FDH)	Mean_Network (CR-FDH)
0	NN	NN
10	NN	NN
20	NN	4.7
30	33.3	12.0
40	50.0	19.2
50	50.0	26.4
60	50.0	33.7
70	50.0	40.9
80	50.0	48.2
90	50.0	55.4
100	50.0	62.6

Openness to experience. The permutation test of the general NCA was insignificant, and there were no influential outliers to remove (Table H1 and H2). Therefore, openness to experience is not a necessary condition for high levels of creativity for the entire dataset.

0-25%, 25-50% and 50-75% working from home. The same result was found for all the groups working from home. The 0-25% group had an insignificant result, and after removing one of the outliers, there was no more effect size (Tables H3-H5 and Figure H1). The other groups didn't demonstrate an effect size right away and had a p-value of 1 (Tables H6 and H7 and Figures H2 and H3). So, regardless of the amount an individual works from home, this antecedent is not a necessary condition.

Perceived job autonomy. The permutation test of the general NCA of creativity (outcome) and job autonomy (condition) was just about insignificant (Table I1). When looking at the outliers, there appeared to be some influential outliers (Table I2). Separate NCA's without respondents 55 and 17 were conducted, but both permutation tests were insignificant (Tables I3 and I4). A third NCA was conducted without respondent 3, since this respondent was also an influential outlier. The permutation test of this NCA was significant (Table 4-3). The effect sizes were quite high, with values of .486 (CE-FDH) and .386 (CR-FDH). According to Dul (2021) these effect sizes can be categorized as large. This means that perceived job autonomy for the entire dataset without respondent 3 is a necessary condition for individual creativity.

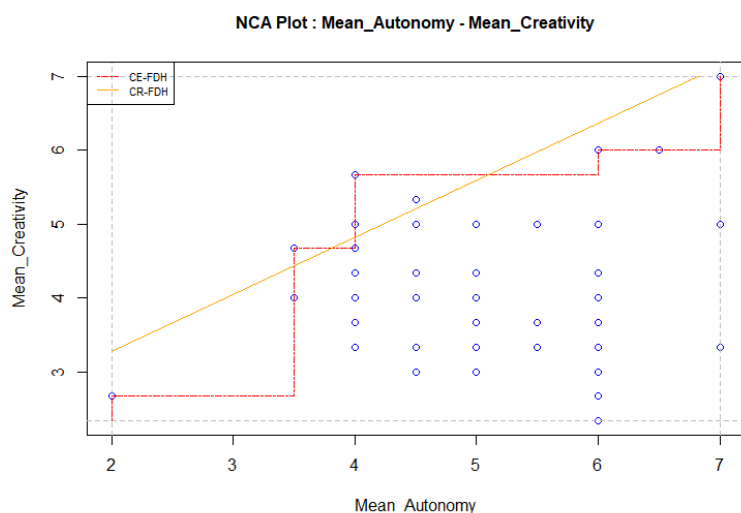
Table 4-3 Results of the NCA

	CE-FDH	CR-FDH
Ceiling zone	11.333	9.010
Effect size	0.486	0.386
# above	0	4
c-accuracy	100%	92.7%
Fit	100%	79.5%

p-value	0.004	0.005
p-accuracy	0.000	0.000

When looking at the plot, quite a big empty zone is shown in the upper left corner (Figure 4-2).

Figure 4-2 Plot ceiling lines representing the necessity relationship between perceived job autonomy and individual creativity for the dataset without respondent 3



The bottleneck table shows that for 80% of the maximum possible creativity score (which is a score of 5.6 on the Likert scale), a score of 72.5% is needed of the maximum possible autonomy (Table 4-4). For 90% creativity, this is 84.6% and for the maximum score of creativity (100%) this is 96.7%. The CE-FDH results support this in a stepwise manner, but these results are, as said, more conservative. From 80-100% score on creativity, a score of 100% on autonomy is needed according to this measurement. For a score of 60-70% creativity, a score of 40% autonomy is needed and onwards from 10-50%, a score of 30% on autonomy is needed.

Table 4-4 Bottleneck table listing the levels of perceived job autonomy necessary to achieve specific levels of individual creativity

Creativity (%)	CE-FDH	CR-FDH
0	NN	NN
10	30.0	NN
20	30.0	NN
30	30.0	11.9
40	30.0	24.1
50	30.0	36.2
60	40.0	48.3
70	40.0	60.4
80	100.0	72.5
90	100.0	84.6
100	100.0	96.7

Therefore, the dataset without respondent 3 shows that job autonomy is a necessary condition for (high levels) of creativity. Not having high work autonomy therefore constrains achieving high levels of creativity. Further analysis showed that respondent 3 had a 60% score on working from home. Hence, this analysis will be done without respondent 3.

0-25% working from home. The NCA for this group showed that job autonomy is a necessary condition for high levels of individual creativity. The permutation test was significant for both measurement types ($p < 0.05$) and the effect sizes (.345 for CE-FDH and .275 for CR-FDH) can be

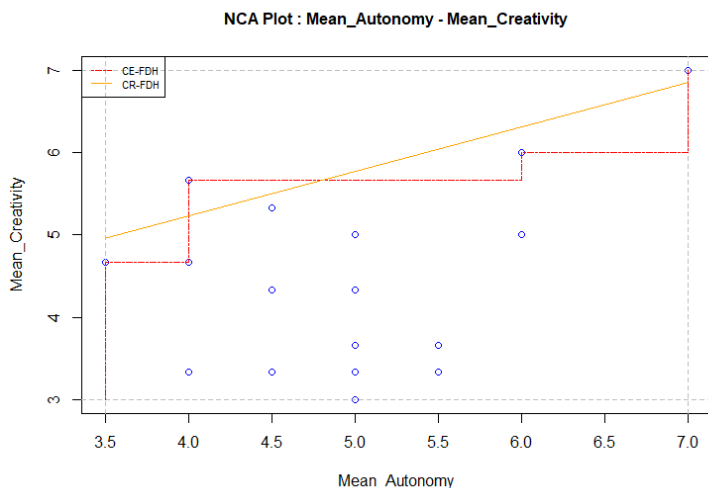
considered as medium to large (Dul, 2021) (Table 4-5). This result means that not having (high levels of) job autonomy constrains achieving high levels of creativity.

Table 4-5 *Results of the NCA*

	CE-FDH	CR-FDH
Ceiling zone	4.833	3.847
Effect size	0.345	0.275
# above	0	2
c-accuracy	100%	91.3%
Fit	100%	79.6%
p-value	0.047	0.038
p-accuracy	0.001	0.001

The plot shows a large empty space in the upper left corner (Figure 4-3).

Figure 4-3 *Plot ceiling lines representing the necessity relationship between perceived job autonomy and individual creativity*



According to the bottleneck table, the CR-FDH method indicates that to reach 80% of the maximum level of creativity, a score of at least 65.8% on work autonomy is needed (Table 4-6). To reach 90% this increases to 87%. For a 100% score on creativity, the bottleneck table shows 'NA' (Not available) for autonomy. According to Dul (2021), this indicates that it is not possible to compute a required level of the condition (autonomy) for achieving the maximum level of the outcome (creativity). This happens when the ceiling line does not reach the top right corner of the plot, which is the case with the CR-FDH method (see Figure 4-3). The CE-FDH results support these outcomes in a stepwise manner, but the results are more conservative. From 80-100% creativity, a score of 100% is needed on autonomy.

Table 4-6 Bottleneck table listing the levels of perceived job autonomy necessary to achieve specific levels of individual creativity

Creativity (%)	CE-FDH	CR-FDH
0	NN	NN
10	NN	NN

20	NN	NN
30	NN	NN
40	NN	NN
50	14.3	2.3
60	14.3	23.5
70	71.4	44.7
80	100.0	65.8
90	100.0	87.0
100	100.0	NA

For the group that works (almost) completely from the office, perceived job autonomy is a necessary condition for high levels of individual creativity. Not having this perceived autonomy constrains high levels of individual creativity.

25-50% and 50% or more working from home. The permutation test of the NCA with these two groups of respondents turned out to be insignificant (Table I5 and I6 and Figure I1). This means that job autonomy is not a necessary condition for creativity for these two specific groups.

New reliability and validity analysis without respondent 3. Because respondent 3 was deleted for this NCA, a new Cronbach's alpha and factor analysis was performed for creativity and autonomy with the new dataset. This led to the retention of all creativity items and to the exclusion of one of the autonomy items, just like before. See Appendix J for the full analysis.

Transformational leadership. The general NCA of perceived transformational leadership led to an insignificant permutation test, without an effect size, nor a ceiling line in the plot (Table K1 and

Figure K1). This means that, for the entire dataset, perceived transformational leadership is not a necessary condition for creativity.

0-25%, 25-50% and 50-75% working from home. When differentiating to the three different working contexts, none of them showed a significant permutation test. The group of 0-25% had a p-value of 1, no effect size and no ceiling line (Table K2). The other two groups did have (very low) effect sizes, but the p-values were insignificant (Table K3 and K4).

Therefore, it can be concluded that perceived transformational leadership is not a necessary condition for creativity, regardless of the amount an individual works from home.

5. Discussion

This study investigated whether the commonly acknowledged antecedents of individual creativity – open network, openness for experience, perceived job autonomy, and perceived transformational leadership – function as necessary conditions for high levels of creativity to occur. Additionally, this research tested whether the necessity differs across traditional office, hybrid and more remote work environments. The findings offer three core theoretical contributions.

5.1 Theoretical implications

First, this study demonstrated that individual creativity can be constrained by just one specific antecedent: perceived job autonomy. Across all conducted NCAs, only job autonomy emerged as a critical limiting factor for (high levels) of individual creativity in the entire dataset. This confirms and supports prior theoretical claims that job autonomy is important for individual creativity (e.g. Amabile & Pratt, 2016; Gagné & Deci, 2005; Liu et al., 2016; Ohly & Fritz, 2010; Bledow et al., 2021). Without a minimal degree of job autonomy, there is no space to experiment, take initiative or deviate from prescribed routines (Tierney & Farmer, 2002; Hackman & Oldham, 1976). Rather than simply demonstrating that job autonomy is a positive predictor of individual creativity, this study shows that without sufficient job autonomy, individuals are effectively blocked from reaching high levels of individual creativity. In this way, job autonomy acts as a bottleneck that can suppress

creative potential. The study thus contributes to the literature by providing empirical and theoretical evidence that job autonomy is a necessary condition, answering calls from the literature to investigate which antecedents of creativity are more important than others (Gottfredson et al., 2025).

Second, this study reveals that openness to experience, open network and perceived transformational leadership are not necessary conditions for high levels of creativity. Although prior research identified these antecedents as (very) important predictors (e.g. George & Zhou, 2001; Xu et al., 2018; Mannucci & Perry-Smith, 202; Anderson et al., 2014; Kaya, 2024), and one study even identified open network as a necessary condition (Breet, 2022), this analysis shows that their absence does not prevent high levels of creativity from occurring. These findings underline Dul's (2016, 2021) argument that correlation doesn't imply necessity. These findings encourage re-evaluation of how these antecedents are conceptualized in creativity research – particularly distinguishing supporting factors from indispensable ones. Furthermore, it adds to the emerging research regarding the antecedents as creativity, confirming that these might be important predictors, but not necessary conditions. Lastly, it also answers one of the calls in the literature to investigate which of the many antecedents of creativity are more important than others (Gottfredson et al., 2025).

Third, this study shows that the necessity of the antecedents is in some cases context dependent. This research found that perceived job autonomy was – next to its necessity for the entire dataset, independent of work context – only a necessary condition for the group working 0-25% from home. Furthermore, having an open network was only a necessary condition for the 50-75% working from home group, which is in direct contrast with the hypothesis. This adds to literature by moving beyond the one-size fits all assumptions and taking into account the context in which the antecedents operate. It adds more nuance to existing models of individual creativity and encourages more tailored approaches. Furthermore, these findings deepen our understanding of the impact of

working from home, which has been a rising trend in the last few years (Galanti et al., 2021; Wang et al., 2020; Yang et al., 2022; Deepa et al., 2023).

5.2 Practical implications

First, this study shows the critical importance of job autonomy as a key enabler for high levels of individual creativity. For organizations trying to foster creative output of employees, especially those working on site (0-25%), ensuring that there is enough job autonomy is not optional, but a prerequisite. As such, organizations should invest in ensuring that employees experience enough job autonomy when working. To achieve this, organizations should assess and perhaps redesign job roles to allow more freedom in task execution, decision-making and scheduling. Enabling employees to experiment, take initiative and deviate from prescribed routines is essential for unlocking the creative potential of employees.

Second, the study shows that having an open network is a necessary condition when working 50-75% from home. These environments weaken social exchanges, informal collaboration and access to diverse ideas, leading to a more closed network. Organizations should therefore foster open networks by facilitating cross-functional communication and encouraging knowledge sharing across employees. Furthermore, organizations may have to consider decreasing the amount employees work from home (<50%), since this boosts communication and this study shows that having an open network is not a necessary condition in these work contexts. Some practical interventions for organizations might be, for example, organizing network events or developing digital collaboration programs for more hybrid teams. This exposes employees to more diverse views, and it boosts communication and networking opportunities, possibly increasing the network openness of employees, thus leading to creative benefits.

5.3 Limitations and future research

This study has several limitations, which in turn create opportunities for future research. First, the study is limited by its relatively small sample size, particularly within the subgroups based on the

level of working from home. This limits the generalizability of the results, as the statistical power might not be sufficient to detect more subtle necessity relationships. This begs the question whether the results would turn out to be the same when conducting the NCA on a larger sample. Future research should use larger samples to validate the results in this study, especially since this study has been the only one researching the necessity relationships between the antecedents and creativity. Larger and more diverse samples would enhance the generalizability of the findings and allow for more robust subgroup analyses depending on the different work contexts.

Second, the use of self-reported survey data brings the risk of subjective bias. All variables, including creativity and the antecedents, were measured through individual perceptions rather than objective indicators. This raises the question whether to what extent the subjective judgement of the individual would match more objective measures. This limitation is especially relevant for the measure of open network. Most research uses Burt's (1992) inverse constraint measure, which is purely objective and offers a more reliable outcome. Future research should consider using more objective measures to prevent the possibility of subjective biases. By using objective measures, there is no risk of any biases, which in turn boosts the reliability of the results.

Another limitation was the fact that none of the respondents worked fully remotely (75% or more). The most amount a respondent worked from home was only 60%. As a result, the effects of working fully remotely on creativity and its antecedents couldn't be assessed. Future research should include this group into their sample to investigate the potential effect this work context has on the necessity of the antecedents. Studies using all the groups (fully from the office, hybrid and fully remote) will offer complete insight into how different work contexts influence the necessity of the antecedents.

6. Conclusion

This study applied a necessity logic framework to examine whether multiple antecedents, which are consistently linked to enhance individual creativity, are truly necessary conditions for high levels of

individual creativity. By analyzing this with a relatively new method – the Necessary Condition Analysis – together with contextual variation in work contexts, this study shifts the lens from correlation to necessity. The findings reveal that only perceived job autonomy is a necessary condition for high levels of individual creativity, and, without it, employees can't achieve these high levels. Moreover, the findings suggest that necessity is not static but context-dependent: perceived job autonomy was – next to being necessary for the entire dataset – only necessary for employees working mostly no-site, and having an open network was only a necessary condition employees working more remotely. The other antecedents and groups, despite extensive literature, do not qualify as necessary conditions, but rather as supportive factors. These insights advance literature on creativity and its antecedents by distinguishing bottlenecks from supporting factors and highlighting the role work context can play in the necessity of antecedents.

References

- Acar, O. A., Tarakci, M., & Van Knippenberg, D. (2018). Creativity and Innovation Under Constraints: A Cross-Disciplinary Integrative Review. *Journal of Management*, *45*(1), 96–121. <https://doi.org/10.1177/0149206318805832>
- Amabile, T. M. (1996). *Creativity in context: Update to "The Social Psychology of Creativity."* Westview Press.
- Amabile, T. M., & Pratt, M. G. (2016). The dynamic componential model of creativity and innovation in organizations: Making progress, making meaning. *Research in Organizational Behavior*, *36*, 157–183. <https://doi.org/10.1016/j.riob.2016.10.001>
- Amabile, T. M., & Pratt, M. G. (2016b). The dynamic componential model of creativity and innovation in organizations: Making progress, making meaning. *Research in Organizational Behavior*, *36*, 157–183. <https://doi.org/10.1016/j.riob.2016.10.001>
- Anderson, N., Potočnik, K., & Zhou, J. (2014). Innovation and Creativity in Organizations: A State-of-the-Science Review, Prospective Commentary, and Guiding Framework. *Journal of Management*, *40*(5), 1297-1333. <https://doi.org/10.1177/0149206314527128>.
- Aral, S., & Van Alstyne, M. (2011). The Diversity-Bandwidth trade-off. *American Journal of Sociology*, *117*(1), 90–171. <https://doi.org/10.1086/661238>
- Axtell, C. M., Holman, D. J., Unsworth, K. L., Wall, T. D., Waterson, P. E., & Harrington, E. (2000). Shopfloor innovation: Facilitating the suggestion and implementation of ideas. *Journal of Occupational and Organizational Psychology*, *73*(3), 265–285. <https://doi.org/10.1348/096317900167029>
- Baer, M. (2010). The strength-of-weak-ties perspective on creativity: A comprehensive examination and extension. *Journal of Applied Psychology*, *95*(3), 592–601. <https://doi.org/10.1037/a0018761>
- Barrero, J. M., Bloom, N., & Davis, S. J. (2023). The Evolution of Work from Home. *The Journal of Economic Perspectives*, *37*(4), 23–49. <https://doi.org/10.1257/jep.37.4.23>

Bass, B. M., & Avolio, B. J. (Eds.). (1994). *Improving organizational effectiveness through transformational leadership*. Sage Publications, Inc.

Bass, B.M. (1985), *Leadership and Performance beyond Expectations*. Free Press.

behaviors, and creativity. *Human Relations*, 63(7), 981–

1005. <https://doi.org/10.1177/0018726709349863>

Bledow, R., Kühnel, J., Jin, M., & Kuhl, J. (2021). Breaking the Chains: The Inverted-U-Shaped Relationship Between Action-State Orientation and Creativity Under Low Job Autonomy. *Journal of Management*, 48(4), 905-935. <https://doi.org/10.1177/0149206321996812>.

Breet, S. (2022). A Network Perspective on Corporate Entrepreneurship: How Workplace Relationships Influence Entrepreneurial Behavior. [Doctoral Thesis, Erasmus University Rotterdam].

Brucks, M. S., & Levav, J. (2022). Virtual communication curbs creative idea generation. *Nature*, 605(7908), 108–112. <https://doi.org/10.1038/s41586-022-04643-y>

Brunelle, E., & Fortin, J. (2021). Distance makes the heart grow fonder: An examination of teleworkers' and office workers' job satisfaction through the lens of Self-Determination Theory. *SAGE Open*, 11(1). <https://doi.org/10.1177/2158244020985516>

Burgelman, R. A. (1983). Corporate Entrepreneurship and Strategic Management: Insights from a Process Study. *Management Science*, 29(12), 1349–1364. <https://doi.org/10.1287/mnsc.29.12.1349>

Burt, R. S. (2004). Structural Holes and Good Ideas. *American Journal of Sociology*, 110(2), 349–399. <https://doi.org/10.1086/421787>

Burt, R. S. 1992. *Structural holes: The social structure of competition*. Cambridge, MA: Harvard University Press

Carless, S.A., Wearing, A.J. & Mann, L.A. (2000) Short Measure of Transformational Leadership. *Journal of Business and Psychology* 14(3), 389–405. <https://doi.org/10.1023/A:1022991115523>

- Carlson, K. D., & Wu, J. (2012). The illusion of statistical control: Control variable practice in management research. *Organizational Research Methods*, 15(3), 413–435. <https://doi.org/10.1177/1094428111428817>
- Carnabuci, G. & Diószegi, B. (2015). Social Networks, Cognitive Style, and Innovative Performance: A Contingency Perspective. *Academy of Management Journal*, 58(3), 881–905. <https://doi.org/10.5465/amj.2013.1042>
- Cheng, Y.-T., & Van de Ven, A. H. (1996). Learning the innovation journey: Order out of chaos? *Organization Science*, 7(6), 593–614. <https://doi.org/10.1287/orsc.7.6.593>
- Costa, P.T., & McCrae, R.R. (1992). *Revised NEO Personality Inventory and NEO Five-Factor Inventory (NEO-FFI) professional manual*. Odessa, FL: Psychological Assessment Resources
- Daniels, K., Boocock, G., Glover, J., Hartley, R., & Holland, J. (2009). An experience sampling study of learning, affect, and the demands control support model. *Journal of Applied Psychology*, 94(4), 1003–1017. <https://doi.org/10.1037/a0015517>
- Deepa, V., Baber, H., Shukla, B., Sujatha, R. and Khan, D. (2023). Does lack of social interaction act as a barrier to effectiveness in work from home? COVID-19 and gender. *Journal of Organizational Effectiveness: People and Performance*, 10(1), 94-111. <https://doi.org/10.1108/JOEPP-11-2021-0311>.
- Donnellan, M. B., Oswald, F. L., Baird, B. M., & Lucas, R. E. (2006). The Mini-IPIP Scales: Tiny-yet-effective measures of the Big Five Factors of Personality. *Psychological Assessment*, 18(2), 192–203. <https://doi.org/10.1037/1040-3590.18.2.192>
- Dul, J., Ceylan, C., & Jaspers, F. (2011). Knowledge workers' creativity and the role of the physical work environment. *Human Resource Management*, 50(6), 715–734. <https://doi.org/10.1002/hrm.20454>
- Dul, J., Van der Laan, E., & Kuik, R. (2020). A statistical significance test for Necessary Condition Analysis. *Organizational Research Methods*, 23(2), 385–395. <https://doi.org/10.1177/1094428118795272>

Dul, Jan, Necessary Condition Analysis (NCA) with R (Version 4.0.0): A Quick Start Guide (February 16, 2024).

Based on: Dul, J. (2016) "Necessary Condition Analysis (NCA): Logic and Methodology of 'Necessary but Not Sufficient' Causality." *Organizational Research Methods* 19(1), 10-52; Dul, J. (2020)

"Conducting Necessary Condition Analysis" SAGE Publications ISBN: 9781526460141, Available at SSRN: <https://ssrn.com/abstract=2624981> Dul, J. (2016). Necessary Condition Analysis (NCA): Logic and Methodology of "Necessary but Not Sufficient" Causality. *Organizational Research Methods*, 19(1), 10-52. <https://doi.org/10.1177/1094428115584005>.

Eisenberg, J., Post, C., & DiTomaso, N. (2019). Team Dispersion and Performance: The role of team communication and transformational leadership. *Small Group Research*, 50(3), 348–380. <https://doi.org/10.1177/1046496419827376>

Feist, G. J. (2018). Creativity and the Big Two model of personality: plasticity and stability. *Current Opinion in Behavioral Sciences*, 27, 31–35. <https://doi.org/10.1016/j.cobeha.2018.07.005>

Gagné, M., & Deci, E. L. (2005). Self-determination theory and work motivation. *Journal of Organizational Behavior*, 26(4), 331–362. <https://doi.org/10.1002/job.322>

Gajendran, R. S., & Harrison, D. A. (2007). The good, the bad, and the unknown about telecommuting: Meta-analysis of psychological mediators and individual consequences. *Journal of Applied Psychology*, 92(6), 1524–1541. <https://doi.org/10.1037/0021-9010.92.6.1524>.

Galanti, T., Guidetti, G., Mazzei, E., Zappalà, S., and Toscano, F. (2021). Work from home during the COVID-19 outbreak: the impact on employees' remote work productivity, engagement, and stress. *Journal of Occupational and Environmental Medicine* 63(7), e426–e432. <https://doi.org/10.1097/JOM.0000000000002236>

George, J. M., & Zhou, J. (2001). When openness to experience and conscientiousness are related to creative behavior: An interactional approach. *Journal of Applied Psychology*, 86(3), 513–524. <https://doi.org/10.1037/0021-9010.86.3.513>.

- Gibbs, M., Mengel, F., & Siemroth, C. (2024). Employee innovation during office work, work from home and hybrid work. *Scientific Reports*, 14(1). <https://doi.org/10.1038/s41598-024-67122-6>
- Goldberg, L. R. (1999). A broad-bandwidth, public domain, personality inventory measuring the lower-level facets of several five-factor models. In I. Mervielde, I. Deary, F. De Fruyt, & F. Ostendorf (Eds.), *Personality psychology in Europe* (Vol. 7, pp. 7–28). Tilburg University Press
- Gong, Y., Huang, J., & Farh, J. (2009). Employee learning orientation, transformational leadership, and employee Creativity: the mediating role of employee Creative Self-Efficacy. *Academy of Management Journal*, 52(4), 765–778. <https://doi.org/10.5465/amj.2009.43670890>
- Gottfredson, R. K., Darden, T. R., & Rajaram, K. (2025). Exploring the antecedents of employee innovative behavior: Learning goal orientation is key. *Journal of General Management*. <https://doi.org/10.1177/03063070251322858>
- Granovetter, M. S. (1973). The strength of weak ties. *American Journal of Sociology*, 78(6), 1360–1380. <https://doi.org/10.1086/225469>
- Grosser, T. J., Obstfeld, D., Labianca, G., & Borgatti, S. P. (2018). Measuring Mediation and Separation Brokerage orientations: A further step toward studying the social network brokerage process. *Academy of Management Discoveries*, 5(2), 114–136. <https://doi.org/10.5465/amd.2017.0110>
- Grosul, M., & Feist, G. J. (2013). The creative person in science. *Psychology of Aesthetics Creativity and the Arts*, 8(1), 30–43. <https://doi.org/10.1037/a0034828>
- Gumusluoglu, L., & Ilsev, A. (2009). Transformational leadership, creativity, and organizational innovation. *Journal of Business Research*, 62(4), 461–473. <https://doi.org/10.1016/j.jbusres.2007.07.032>
- Hackman, J. R., & Oldham, G. R. (1975). Development of the Job Diagnostic Survey. *Journal of Applied Psychology*, 60(2), 159-170. <https://doi.org/10.1037/h0076546>

- Hackman, J., & Oldham, G. R. (1976). Motivation through the design of work: test of a theory. *Organizational Behavior and Human Performance*, 16(2), 250–279. [https://doi.org/10.1016/0030-5073\(76\)90016-7](https://doi.org/10.1016/0030-5073(76)90016-7)
- Hüttemann, D., Härtel, T. M., & Müller, J. (2025). Examining the extended full-range leadership model and leadership effectiveness in remote work contexts: the moderating role of VUCA environments. *Leadership & Organization Development Journal*, 46(1), 1-22. <https://doi.org/10.1108/lodj-07-2024-0475>
- Iorio, A. (2022). Brokers in Disguise: The Joint Effect of Actual Brokerage and Socially Perceived Brokerage on Network Advantage. *Administrative Science Quarterly*, 67(3), 769-820. <https://doi.org/10.1177/00018392221092242>
- Jung, D. I., Chow, C., & Wu, A. (2003). The role of transformational leadership in enhancing organizational innovation: Hypotheses and some preliminary findings. *The Leadership Quarterly*, 14(4–5), 525–544. [https://doi.org/10.1016/s1048-9843\(03\)00050-x](https://doi.org/10.1016/s1048-9843(03)00050-x)
- Kaya, A. (2024). The association between transformational leadership and teachers' creativity: professional resilience and job satisfaction as mediators. *Frontiers in Psychology*, 15. <https://doi.org/10.3389/fpsyg.2024.1514621>
- Kelloway, E.K., Barling, J., Kelley, E., Comtois, J. and Gatién, B. (2003), Remote transformational leadership. *Leadership & Organization Development Journal*, 24(3), 163-171. <https://doi.org/10.1108/01437730310469589>
- Khalili, A. (2016). Linking transformational leadership, creativity, innovation, and innovation-supportive climate. *Management Decision*, 54(9), 2277–2293. <https://doi.org/10.1108/MD-03-2016-0196>
- Kijkuit, B., & van den Ende, J. (2007). The organizational life of an idea: Integrating social network, creativity and decision-making perspectives. *Journal of Management Studies*, 44(6), 863–882. <https://doi.org/10.1111/j.1467-6486.2007.00695.x>

- Kirchner, K., Ipsen, C., & Hansen, J. P. (2021). COVID-19 leadership challenges in knowledge work. *Knowledge Management Research & Practice*, 19(4), 493–500. <https://doi.org/10.1080/14778238.2021.1877579>
- Langfred, C. W., & Moye, N. A. (2004). Effects of Task Autonomy on Performance: An Extended Model Considering Motivational, Informational, and Structural Mechanisms. *Journal of Applied Psychology*, 89(6), 934–945. <https://doi.org/10.1037/0021-9010.89.6.934>
- Leroy, S., Schmidt, A. M., & Madjar, N. (2021). Working from home during COVID-19: A study of the interruption landscape. *Journal of Applied Psychology*, 106(10), 1448–1465. <https://doi.org/10.1037/apl0000972>
- Liebermann, S. C., Blenckner, K., Diehl, J., Feilke, J., Frei, C., Grikscheit, S., Hünsch, S., Kohring, K., Lay, J., Lorenzen, G., & Reinhardt, J. (2021). Abrupt implementation of telework in the public sector during the COVID-19 crisis. *Zeitschrift Für Arbeits- Und Organisationspsychologie a&O*, 65(4), 258–266. <https://doi.org/10.1026/0932-4089/a000367>
- Lin, Y., Frey, C. B., & Wu, L. (2023). Remote collaboration fuses fewer breakthrough ideas. *Nature*, 623(7989), 987–991. <https://doi.org/10.1038/s41586-023-06767-1>
- Liu, D., Jiang, K., Shalley, C. E., Keem, S., & Zhou, J. (2016). Motivational mechanisms of employee creativity: A meta-analytic examination and theoretical extension of the creativity literature. *Organizational Behavior and Human Decision Processes*, 137, 236–263. <https://doi.org/10.1016/j.obhdp.2016.08.001>
- Madjar, N., Oldham, G. R., & Pratt, M. G. (2002). There's No Place like Home? The Contributions of Work and Nonwork Creativity Support to Employees' Creative Performance. *Academy of Management Journal*, 45(4), 757–767. <https://doi.org/10.2307/3069309>
- Mannucci, P. V., & Perry-Smith, J. E. (2022). “Who are you going to call?” Network activation in creative idea generation and elaboration. *Academy of Management Journal*, 65(4), 1192–1217. <https://doi.org/10.5465/amj.2019.0333>

- Maurer, M., Bach, N., & Oertel, S. (2022). Forced to go virtual. Working-from-home arrangements and their effect on team communication during COVID-19 lockdown. *German Journal of Human Resource Management*, 36(3), 238-269. <https://doi.org/10.1177/23970022221083698>
- McAlpine, K. L. (2018). Flexible work and the effect of informal communication on idea generation and innovation. *Academy of Management Proceedings*, 2018(1), 15092. <https://doi.org/10.5465/ambpp.2018.205>
- McCrae, R. R. (1987). Creativity, divergent thinking, and openness to experience. *Journal of Personality and Social Psychology*, 52(6), 1258–1265. <https://doi.org/10.1037/0022-3514.52.6.1258>
- McCrae, R. R. (1996). Social consequences of experiential openness. *Psychological Bulletin*, 120(3), 323–337. <https://doi.org/10.1037/0033-2909.120.3.323>
- McCrae, R. R., & Costa, P. T., Jr. (1997). Conceptions and correlates of openness to experience. In R. Hogan, J. A. Johnson, & S. R. Briggs (Eds.), *Handbook of personality psychology* (pp. 825–847). Academic Press. <https://doi.org/10.1016/B978-012134645-4/50032-9>
- Miron-Spektor, E., Erez, M., & Naveh, E. (2011). The effect of conformist and attentive-to-detail members on team innovation: Reconciling the innovation paradox. *Academy of Management Journal*, 54(4), 740–760. <https://doi.org/10.5465/AMJ.2011.64870100>
- Morgeson, F. P., & Humphrey, S. E. (2006). The Work Design Questionnaire (WDQ): Developing and validating a comprehensive measure for assessing job design and the nature of work. *Journal of Applied Psychology*, 91(6), 1321–1339. <https://doi.org/10.1037/0021-9010.91.6.1321>
- Neufeld, D. J., Wan, Z., & Fang, Y. (2010). Remote leadership, communication effectiveness and leader performance. *Group Decision and Negotiation*, 19(3), 227–246. <https://doi.org/10.1007/s10726-008-9142-x>

- Obstfeld, D. (2005). Social Networks, the Tertius Iungens Orientation, and Involvement in Innovation. *Administrative Science Quarterly*, 50(1), 100-130. <https://doi.org/10.2189/asqu.2005.50.1.100>.
- Ohly, S., & Fritz, C. (2009). Work characteristics, challenge appraisal, creativity, and proactive behavior: A multi-level study. *Journal of Organizational Behavior*, 31(4), 543–565. <https://doi.org/10.1002/job.633>
- Oldham, G. R., & Cummings, A. (1996). Employee creativity: Personal and contextual factors at work. *Academy of Management Journal*, 39(3), 607–634. <https://doi.org/10.2307/256657>
- Ouakouak, M.L. & Ouedraogo, N. (2017). Antecedents Of Employee Creativity And Organisational Innovation: An Empirical Study. *International Journal of Innovation Management*. 21(07), 1-26. <https://doi.org/10.1142/s1363919617500608>
- Parker, S. K., Wall, T. D., & Jackson, P. R. (1997). "That's not my job": Developing flexible employee work orientations. *Academy of Management Journal*, 40(4), 899–929. <https://doi.org/10.2307/256952>
- Perry-Smith, J. E., & Mannucci, P. V. (2017). From creativity to innovation: The social network drivers of the four phases of the idea journey. *The Academy of Management Review*, 42(1), 53–79. <https://doi.org/10.5465/amr.2014.0462>
- Petrou, P. , van der Linden, D. & Bakker, A. B. (2023). Effects of Openness on Incremental Versus Radical Creativity and the Moderating Role of Leader Behaviors. *Journal of Individual Differences*, 44 (3), 190-204. doi: 10.1027/1614-0001/a000393
- Podsakoff, P. M., MacKenzie, S. B., Moorman, R. H., & Fetter, R. (1990). Transformational leader behaviors and their effects on followers' trust in leader, satisfaction, and organizational citizenship behaviors. *The Leadership Quarterly*, 1(2), 107–142. [https://doi.org/10.1016/1048-9843\(90\)90009-7](https://doi.org/10.1016/1048-9843(90)90009-7)
- Purvanova, R. K., & Bono, J. E. (2009). Transformational leadership in context: Face-to-face and virtual teams. *The Leadership Quarterly*, 20(3), 343–357. <https://doi.org/10.1016/j.leaqua.2009.03.004>

- Raja, U., & Johns, G. (2010). The joint effects of personality and job scope on in-role performance, citizenship
- Rietveld, J. R., Hiemstra, D., Brouwer, A. E., & Waalkens, J. (2021). Motivation and Productivity of Employees in Higher Education during the First Lockdown. *Administrative Sciences*, 12(1), 1. <https://doi.org/10.3390/admsci12010001>
- Rogan, M., & Mors, M. L. (2014). A Network Perspective on Individual-Level Ambidexterity in Organizations. *Organization Science*, 25(6), 1860–1877. <https://doi.org/10.1287/orsc.2014.0901>
- Sapiyi, S., and Suradi, N.R.M. & Mustafa, Z. (2022). A new imperative of relationship between individual creativity and organisational innovation: a systematic review. *Journal of Quality Measurement and Analysis*, 18(2), 45-63.
- Shin, S. J., & Zhou, J. (2003). Transformational leadership, Conservation, and Creativity: evidence from Korea. *Academy of Management Journal*, 46(6), 703–714. <https://doi.org/10.5465/30040662>
- Shockley, K. M., Gabriel, A. S., Robertson, D., Rosen, C. C., Chawla, N., Ganster, M. L., & Ezerins, M. E. (2021). The fatiguing effects of camera use in virtual meetings: A within-person field experiment. *Journal of Applied Psychology*, 106(8), 1137–1155. <https://doi.org/10.1037/apl0000948>.
- Sidelkivska, V., & Bilbao-Calabuig, P. (2023). Conceptualizing cognitive and behavioral elements of individual's creativity and innovation: systematic literature review. *Innovation: The European Journal of Social Science Research*, 1–28. <https://doi.org/10.1080/13511610.2023.2231161>.
- Silvia, P. J., Beaty, R. E., Nusbaum, E. C., Eddington, K. M., Levin-Aspenson, H., & Kwapil, T. R. (2014). Everyday creativity in daily life: An experience-sampling study of “little c” creativity. *Psychology of Aesthetics, Creativity, and the Arts*, 8(2), 183–188. <https://doi.org/10.1037/a0035722>
- Soda, G., Mannucci, P. V., & Burt, R. S. (2021). Networks, Creativity, and Time: Staying Creative through Brokerage and Network Rejuvenation. *Academy of Management Journal*, 64(4), 1164–1190. <https://doi.org/10.5465/amj.2019.1209>

- Soda, G., Stea, D., & Pedersen, T. (2019). Network Structure, Collaborative Context, and Individual Creativity. *Journal of Management*, 45(4), 1739-1765. <https://doi.org/10.1177/0149206317724509>.
- Tan, C., Lau, X., Kung, Y., & Kailsan, R. A. (2019). Openness to experience enhances creativity: the mediating role of intrinsic motivation and the creative process engagement. *The Journal of Creative Behavior*, 53(1), 109–119. <https://doi.org/10.1002/jocb.170>
- Tautz, D. C., Schübbe, K., & Felfe, J. (2022). Working from home and its challenges for transformational and health-oriented leadership. *Frontiers in Psychology*, 13. <https://doi.org/10.3389/fpsyg.2022.1017316>
- Tidikis, V., & Dunbar, N. D. (2019). Openness to experience and creativity: When does global citizenship matter?. *International journal of psychology : Journal internationale de psychologie*, 54(2), 264–268. <https://doi.org/10.1002/ijop.12463>
- Tierney, P. (2008). Leadership and creativity. In J. Zhou & C. E. Shalley (Eds.), *Handbook of organizational creativity* (pp. 95–124). Erlbaum
- Tierney, P., & Farmer, S. M. (2002). Creative self-efficacy: Its potential antecedents and relationship to creative performance. *Academy of Management Journal*, 45(6), 1137–1148. <https://doi.org/10.2307/3069429>
- Tierney, P., & Farmer, S. M. (2004). The Pygmalion Process and Employee Creativity. *Journal of Management*, 30(3), 413–432. <https://doi.org/10.1016/j.jm.2002.12.001>
- Tierney, P., Farmer, S.M. & Graen, G.B. (1999), An examination of leadership and employee creativity: the relevance of traits and relationships. *Personnel Psychology*, 52(3), 591–620. <https://doi.org/10.1111/j.1744-6570.1999.tb00173.x>
- Wang, B., Liu, Y., Qian, J., & Parker, S. K. (2021). Achieving Effective Remote Working During the COVID-19 Pandemic: A Work Design Perspective. *Applied psychology = Psychologie appliquee*, 70(1), 16–59. <https://doi.org/10.1111/apps.12290>

- Wang, W., Albert, L., & Sun, Q. (2020). Employee isolation and telecommuter organizational commitment. *Employee Relations*, 42(3), 609–625. <https://doi.org/10.1108/ER-06-2019-0246>
- Woodman, R. W., Sawyer, J. E., & Griffin, R. W. (1993). Toward a Theory of Organizational Creativity. *The Academy of Management Review*, 18(2), 293–321. <https://doi.org/10.2307/258761>
- Xu, S., Jiang, X., & Walsh, I. J. (2018). The influence of openness to experience on perceived employee creativity: the moderating roles of individual trust. *The Journal of Creative Behavior*, 52(2), 142–155. <https://doi.org/10.1002/jocb.138>
- Yang, L., Holtz, D., Jaffe, S., Suri, S., Sinha, S., Weston, J., Joyce, C., Shah, N., Sherman, K., Hecht, B., & Teevan, J. (2022). The effects of remote work on collaboration among information workers. *Nature human behaviour*, 6(1), 43–54. <https://doi.org/10.1038/s41562-021-01196-4>
- Zhou, J., & Hoever, I. J. (2014). Research on workplace creativity: A review and redirection. *Annual Review of Organizational Psychology and Organizational Behavior*, 1, 333–359. <https://doi.org/10.1146/annurev-orgpsych-031413-091226>
- Zhou, N.J., Shin, S. J., & Cannella, A. A. (2008). Employee Self-Perceived Creativity after mergers and acquisitions. *The Journal of Applied Behavioral Science*, 44(4), 397-421. <https://doi.org/10.1177/0021886308328010>

Appendices

Appendix A

Validation of the Creativity Measure

Descriptive and visual analyses (skewness, kurtosis, Q–Q plots, and boxplots) indicated that the three creativity items were normally distributed, with only one mild outlier (case 50) that fell within a valid range and was therefore retained (Table A2 and figures A1 and A2). The self-perceived creativity scale demonstrated high reliability ($\alpha = .890$), with all three items contributing meaningfully and they were therefore all retained (Tables A3 and A4). The data was deemed suitable for factor analysis based on an adequate KMO value (0.747) and a significant Bartlett's test of sphericity ($p < 0.001$) (Table A6). The analysis showed that all communalities exceeded 0.68. Furthermore, the factor analysis indicated one factor with an eigenvalue > 1 , which explained over 60% of the variance, and the scree plot indicated a clear inflection point for one factor (Tables A7 and A8, and figure A3). Strong factor loadings confirmed that the items reflect a single underlying construct (Table A9). Therefore, all items were retained.

Table A1

Self-perceived creativity items (Dul et al. 2011)

Self perceived creativity
In my work, I often have new and innovative ideas
In my work, I often come up with creative solutions to problems
In my work, I often suggest new ways of performing work tasks

Table A2

Descriptive statistics of the creativity items

Descriptives				
			Statistic	Std. Error
Creativity1	Mean		4,09	,156
	95% Confidence Interval for Mean	Lower Bound	3,78	
		Upper Bound	4,40	
	5% Trimmed Mean		4,06	
	Median		4,00	
	Variance		1,356	
	Std. Deviation		1,164	
	Minimum		2	
	Maximum		7	
	Range		5	
	Interquartile Range		2	
	Skewness		,394	,319
	Kurtosis		-,658	,628
	Creativity2	Mean		4,30
95% Confidence Interval for Mean		Lower Bound	4,03	
		Upper Bound	4,57	
5% Trimmed Mean			4,26	
Median			4,00	
Variance			1,015	
Std. Deviation			1,008	
Minimum			3	
Maximum			7	
Range			4	
Interquartile Range			1	
Skewness			,453	,319
Kurtosis			-,342	,628
Creativity3		Mean		3,89
	95% Confidence Interval for Mean	Lower Bound	3,55	
		Upper Bound	4,24	
	5% Trimmed Mean		3,86	
	Median		4,00	
	Variance		1,661	
	Std. Deviation		1,289	
	Minimum		2	
	Maximum		7	
	Range		5	
	Interquartile Range		2	
	Skewness		,471	,319
	Kurtosis		-,521	,628

Figure A1

Q-Q plot of one of the creativity items

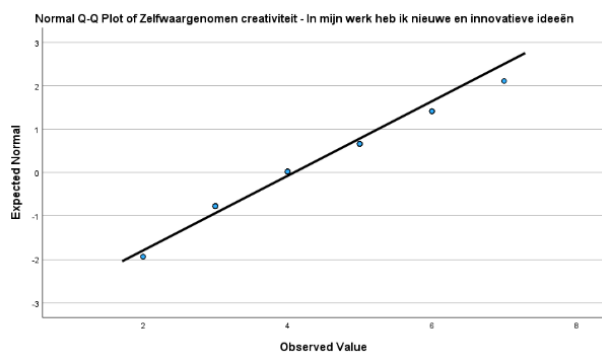


Figure A2

Boxplot of the creativity measure

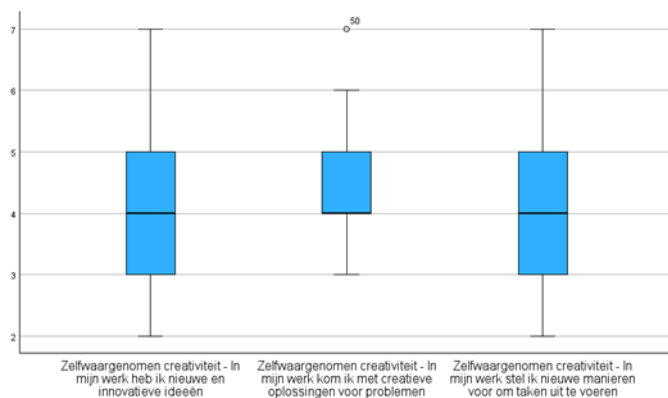


Table A3

Cronbach's alpha of the creativity measure

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
,890	,895	3

Table A4

Item-total statistics of the creativity measure

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
Creativity1	8,20	4,524	,815	,664	,817
Creativity2	7,98	5,327	,769	,593	,867
Creativity3	8,39	4,097	,797	,639	,843

Table A6

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		,747
Bartlett's Test of Sphericity	Approx. Chi-Square	95,571
	df	3
	Sig.	<,001

Table A7

Communalities

	Initial	Extraction
Creativity1	,664	,795
Creativity2	,593	,681
Creativity3	,639	,745

Extraction Method: Principal Axis Factoring.

Table A8

Total Variance Explained

Factor	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	2,478	82,616	82,616	2,221	74,018	74,018
2	,295	9,818	92,434			
3	,227	7,566	100,000			

Extraction Method: Principal Axis Factoring.

Figure A3

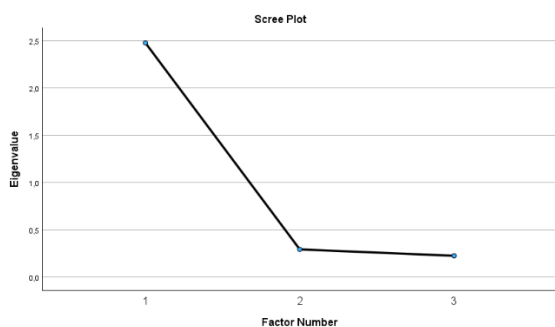


Table A9

Factor Matrix^a

	Factor
	1
Creativity1	,891
Creativity2	,825
Creativity3	,863

Extraction Method: Principal Axis Factoring.

a. 1 factors extracted. 8 iterations required.

Appendix B

Validation of the Open Network Measure

Descriptive and visual analyses indicated normal distribution for the open network items, with only a few mild but valid outliers that were retained (Table B2 and figures B1 and B2). The open network scale demonstrated acceptable reliability ($\alpha = .789$), with all five items contributing meaningfully and were thus retained, despite a minimal potential increase by removing one item (Tables B3 and B4). In the first factor analysis, which showed an acceptable KMO and a significant Bartlett's test (Table B5), item Network5 was deleted due to a very low communality value (0.221) and weak (cross-)factor loading (Table B6 and B7). The second factor analysis without Network5 showed an acceptable KMO-value and a significant Bartlett's test (Table B8). However, item Network4 was deleted for the same reasons; a very low communality value and weak factor loading (Tables B9 and B10). The third factor analysis, without Network5 and Network4, showed an acceptable KMO-value and a significant Bartlett's test (Table B11). The communalities were high for all items, one factor was indicated and all items had high factor loadings (Tables B12-14 and figure B3). A new reliability analysis was performed which showed an acceptable Cronbach's alpha value of .875 (Table B16). Therefore, three out of five items were retained in this construct.

Table B1

Open network items (Grosser et al., 2019)

Open network
It can be advantageous to maintain separation between some of my work contacts
It is often better to keep some people from interacting with one another
I prefer to keep some of my work contacts separate from one another
I maintain a set of work contacts who don't know one another
I often hear different perspectives because my work contacts come from diverse circles

Table B2

Descriptive statistics of the open network items

Descriptives				
		Statistic	Std. Error	
Network1	Mean	2,85	,133	
	95% Confidence Interval for Mean	Lower Bound	2,68	
		Upper Bound	3,21	
	5% Trimmed Mean	2,90		
	Median	3,00		
	Variance	,987		
	Std. Deviation	,999		
	Minimum	1		
	Maximum	5		
	Range	4		
	Interquartile Range	2		
	Skewness	-.344	,319	
	Kurtosis	-.879	,828	
	Network2	Mean	2,41	,124
95% Confidence Interval for Mean		Lower Bound	2,16	
		Upper Bound	2,66	
5% Trimmed Mean		2,38		
Median		2,00		
Variance		,865		
Std. Deviation		,930		
Minimum		1		
Maximum		5		
Range		4		
Interquartile Range		1		
Skewness		,004	,319	
Kurtosis		,443	,828	
Network3		Mean	2,73	,138
	95% Confidence Interval for Mean	Lower Bound	2,48	
		Upper Bound	3,00	
	5% Trimmed Mean	2,72		
	Median	3,00		
	Variance	1,028		
	Std. Deviation	1,018		
	Minimum	1		
	Maximum	5		
	Range	4		
	Interquartile Range	1		
	Skewness	-.141	,319	
	Kurtosis	-.514	,828	
	Network4	Mean	2,86	,138
95% Confidence Interval for Mean		Lower Bound	2,58	
		Upper Bound	3,13	
5% Trimmed Mean		2,86		
Median		3,00		
Variance		1,079		
Std. Deviation		1,039		
Minimum		1		
Maximum		5		
Range		4		
Interquartile Range		2		
Skewness		-.219	,319	
Kurtosis		-.755	,828	
Network5		Mean	3,59	,122
	95% Confidence Interval for Mean	Lower Bound	3,35	
		Upper Bound	3,93	
	5% Trimmed Mean	3,52		
	Median	4,00		
	Variance	,828		
	Std. Deviation	,910		
	Minimum	1		
	Maximum	5		
	Range	4		
	Interquartile Range	1		
	Skewness	-.725	,319	
	Kurtosis	,248	,828	

Figure B1

Q-Q plot of one of the open network items

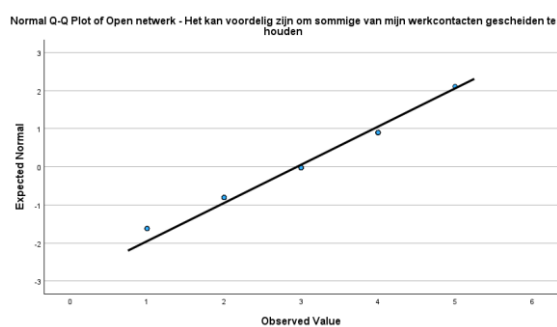


Figure B2

Boxplot of the open network measure

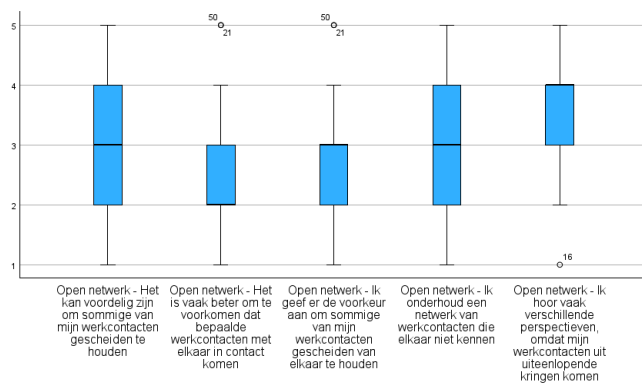


Table B3

Cronbach's alpha of the open network measure

Reliability Statistics		
Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
,789	,787	5

Table B4

Item-total statistics of the open network items

Item-Total Statistics					
	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
Network1	11,59	8,137	,682	,591	,711
Network2	12,13	8,620	,647	,590	,725
Network3	11,80	7,906	,712	,704	,699
Network4	11,68	8,877	,498	,332	,774
Network5	10,95	10,306	,322	,212	,820

Table B5

KMO and Bartlett's Test		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		,688
Bartlett's Test of Sphericity	Approx. Chi-Square	110,604
	df	10
	Sig.	<,001

Table B6

Communalities

	Initial	Extraction
Network1	,591	,616
Network2	,590	,618
Network3	,704	,922
Network4	,332	,764
Network5	,212	,221

Extraction Method: Principal Axis Factoring.

Table B7**Factor Matrix^a**

	Factor	
	1	2
Network1	,779	-,090
Network2	,765	-,183
Network3	,909	-,310
Network4	,604	,632
Network5	,333	,331

Extraction Method: Principal Axis Factoring.

a. Attempted to extract 2 factors. More than 25 iterations required. (Convergence=.010). Extraction was terminated.

Table B8**KMO and Bartlett's Test**

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		,725
Bartlett's Test of Sphericity	Approx. Chi-Square	98,713
	df	6
	Sig.	<,001

Table B9**Communalities**

	Initial	Extraction
Network1	,587	,670
Network2	,584	,642
Network3	,691	,801
Network4	,209	,197

Extraction Method: Principal Axis Factoring.

Table B10

Factor Matrix^a

	Factor 1
Network1	,818
Network2	,801
Network3	,895
Network4	,444

Extraction Method:
Principal Axis
Factoring.

a. 1 factors
extracted. 8
iterations
required.

Table B11**KMO and Bartlett's Test**

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		,706
Bartlett's Test of Sphericity	Approx. Chi-Square	86,903
	df	3
	Sig.	<,001

Table B12**Communalities**

	Initial	Extraction
Network1	,551	,600
Network2	,573	,625
Network3	,688	,904

Extraction Method: Principal Axis
Factoring.

Table B13**Total Variance Explained**

Factor	Total	Initial Eigenvalues		Extraction Sums of Squared Loadings		
		% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	2,402	80,079	80,079	2,129	70,975	70,975
2	,389	12,960	93,040			
3	,209	6,960	100,000			

Extraction Method: Principal Axis Factoring.

Figure B3

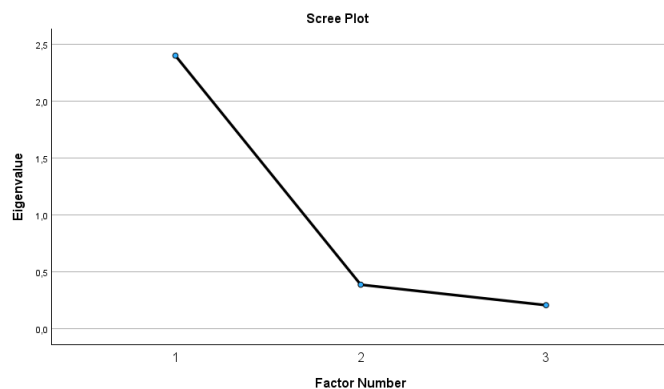


Table B14

Factor Matrix^a

	Factor 1
Network1	,775
Network2	,791
Network3	,951

Extraction Method:
Principal Axis
Factoring.

a. 1 factors
extracted. 14
iterations
required.

Table B16

Cronbach's alpha of the open network measure without items Network4 and Network5

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
,875	,875	3

Appendix C

Validation of the Openness to Experience Measure

Despite a high kurtosis for Openness4 and several outliers in Openness1, 3, and 4, all items were retained as they showed acceptable reliability, fell within valid ranges, didn't indicate data error or implausible responses and normality is not required for NCA (Table C2 and figures C1 and C2). Furthermore, we can later see that removing Openness4 would only reduce the Cronbach's alpha value. The Cronbach's alpha showed in first instance a value of .451 (Table C3). However, after reverse coding the negatively worded items, it increased to a value of 0.707 (Table C4). Removing Openness1 would slightly increase the value, but this improvement was too marginal to justify excluding it, and therefore all four items were retained (Table C5). The first factor analysis showed an acceptable KMO-value and a significant Bartlett's test (Table C6). However, the communality extraction value of Openness1 was very low (.120) and had a weak factor loading (Tables C7 and C8). For this reason, Openness1 was excluded. The second factor analysis also showed an acceptable KMO-value and a significant Bartlett's test (Table C9). Despite the low communality value of Rev_Openness4 (.303), the item was retained given its conceptual relevance (Table C10). The other items had acceptable values, one factor was indicated and all items had strong factor loadings (Tables C11 and C12 and figure C3). Consequently, the following reliability analysis showed good internal consistency ($\alpha = .742$), with no further improvement from item deletion, supporting retention of the three-item scale for further analysis (Tables C13 and C14).

Table C1

Openness to experience items (Donnellan et al., 2006)

Openness to experience
Have a vivid imagination
Am not interested in abstract ideas (R)
Have difficulty understanding abstract ideas (R)
Do not have a good imagination (R)

Note. (R) = Reverse scored item.

Table C2

Descriptive statistics of the openness to experience items

Descriptives				Statistic	Std. Error
Openness1	Mean			3,95	,092
	95% Confidence Interval for Mean	Lower Bound	Upper Bound	3,78	
	95% Confidence Interval for Mean	Lower Bound	Upper Bound	4,11	
	5% Trimmed Mean			3,98	
	Median			4,05	
	Variance			,379	
	Std. Deviation			,616	
	Minimum			2	
	Maximum			5	
	Range			3	
	Interquartile Range			2	
	Skewness			,458	,319
	Kurtosis			1,265	,628
	Openness2	Mean			2,32
95% Confidence Interval for Mean		Lower Bound	Upper Bound	2,07	
95% Confidence Interval for Mean		Lower Bound	Upper Bound	2,58	
5% Trimmed Mean				2,30	
Median				2,09	
Variance				,913	
Std. Deviation				,953	
Minimum				1	
Maximum				4	
Range				3	
Interquartile Range				1	
Skewness				,469	,319
Kurtosis				-,532	,628
Openness3		Mean			2,09
	95% Confidence Interval for Mean	Lower Bound	Upper Bound	1,83	
	95% Confidence Interval for Mean	Lower Bound	Upper Bound	2,35	
	5% Trimmed Mean			2,04	
	Median			2,03	
	Variance			,592	
	Std. Deviation			,769	
	Minimum			1	
	Maximum			4	
	Range			3	
	Interquartile Range			0	
	Skewness			,838	,319
	Kurtosis			1,903	,628
	Openness4	Mean			1,93
95% Confidence Interval for Mean		Lower Bound	Upper Bound	1,75	
95% Confidence Interval for Mean		Lower Bound	Upper Bound	2,11	
5% Trimmed Mean				1,88	
Median				2,09	
Variance				,468	
Std. Deviation				,684	
Minimum				1	
Maximum				5	
Range				4	
Interquartile Range				2	
Skewness				1,865	,319
Kurtosis				7,756	,628

Figure C1

Q-Q plot of one of the openness to experience items

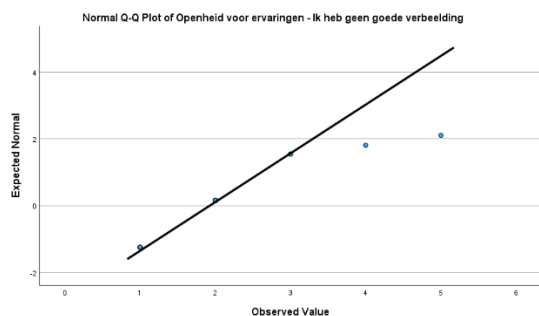


Figure C2

Boxplot of the openness to experience items

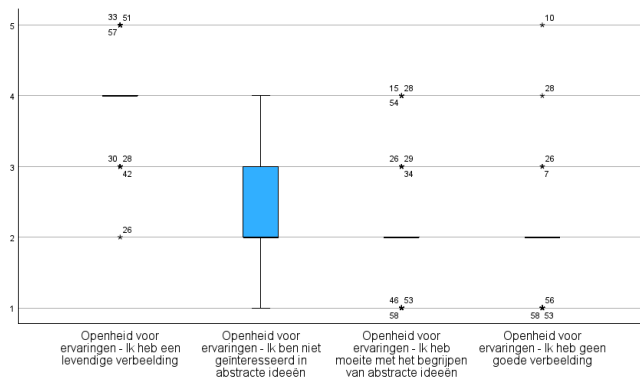


Table C3

Cronbach's alpha of the openness to experience measure

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
,451	,354	4

Table C4

Cronbach's alpha of the open network measure with reversed items

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
,707	,701	4

Table C5

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
Openness1	11,6607	3,901	,299	,130	,742
Rev_Openness2	11,9286	2,322	,608	,465	,571
Rev_Openness3	11,6964	2,833	,610	,416	,569
Rev_Openness4	11,5357	3,308	,495	,277	,646

Table C6

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		,640
Bartlett's Test of Sphericity	Approx. Chi-Square	47,390
	df	6
	Sig.	<,001

Table C7

Communalities

	Initial	Extraction
Openness1	,130	,120
Rev_Openness2	,465	,654
Rev_Openness3	,416	,539
Rev_Openness4	,277	,328

Extraction Method: Principal Axis Factoring.

Table C8

Factor Matrix^a

	Factor 1
Openness1	,346
Rev_Openness2	,809
Rev_Openness3	,734
Rev_Openness4	,573

Extraction Method: Principal Axis Factoring.

a. 1 factors extracted. 11 iterations required.

Table C9

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		,633
Bartlett's Test of Sphericity	Approx. Chi-Square	40,288
	df	3
	Sig.	<,001

Table C10

Communalities

	Initial	Extraction
Rev_Openness2	,462	,852
Rev_Openness3	,368	,426
Rev_Openness4	,263	,303

Extraction Method: Principal Axis Factoring.

Table C11

Total Variance Explained

Factor	Total	Initial Eigenvalues		Extraction Sums of Squared Loadings		
		% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	1,987	66,228	66,228	1,581	52,708	52,708
2	,651	21,684	87,912			
3	,363	12,088	100,000			

Extraction Method: Principal Axis Factoring.

Figure C3

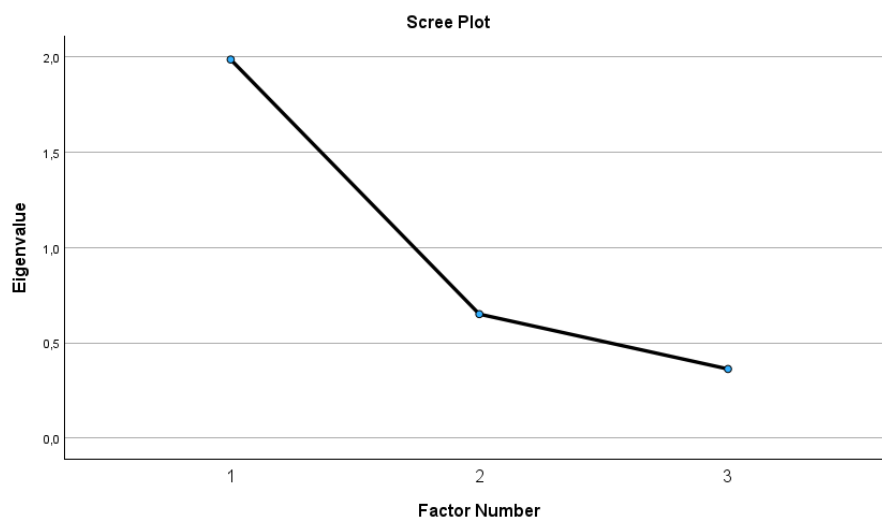


Table C12

Factor Matrix^a

	Factor 1
Rev_Openness2	,923
Rev_Openness3	,653
Rev_Openness4	,550

Extraction Method: Principal Axis Factoring.

a. 1 factors extracted. 23 iterations required.

Table C13

Cronbach's alpha of the open network measure without the item Openness1

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
,742	,742	3

Table C14**Item-Total Statistics**

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
Rev_Openness2	7,9821	1,436	,678	,462	,525
Rev_Openness3	7,7500	2,045	,574	,368	,650
Rev_Openness4	7,5893	2,392	,492	,263	,742

Appendix D

Validation of the Perceived Job Autonomy Measure

Descriptive and visual analyses (Table D2 and figure D1) indicated a normal distribution for the autonomy items, with only a few mild outliers which fell in valid range and did not suggest data errors. The Cronbach's value was only .211 at first, but after reverse-coding the negatively worded item Autonomy2, it improved to .709 which is acceptable (Tables D3-D5). Although removing it would increase the Cronbach's value even more, it was retained to preserve the theoretical conceptualization of work autonomy as captured by the three dimensions (Table D6). The factor analysis showed an acceptable KMO-value and a significant Bartlett's test, but the communality value and factor loading of Rev_Autonomy2 was very low, and was therefore deleted from further analysis (Table D7-D9). The new analysis again showed an acceptable KMO-value and a significant Bartlett's test, with high communalities, one indicated factor and strong factor loading (Table D10-D13 and Figure D2). A new Cronbach's alpha was performed which showed a high value of .903 (Table D14).

Table D1

Perceived job autonomy items (Hackman & Oldham, 1975)

Perceived job autonomy
How much autonomy is there in your job? That is, to what extent does your job permit you to decide on your own how to go about doing the work?
The job denies me any chance to use my personal initiative or judgment in carrying out the work (R)
The job gives me considerable opportunity for independence and freedom in how I do the work.

Note. (R) = Reverse scored Item. First item is a question and will be answered on a scale of very little (1) to very much (7).

Table D2

Descriptive statistics of the perceived job autonomy items

Descriptives				
		Statistic	Std. Error	
Autonomy1	Mean	5,05	,143	
	95% Confidence Interval for Mean	Lower Bound	4,77	
		Upper Bound	5,34	
	5% Trimmed Mean	5,10		
	Median	5,00		
	Variance	1,143		
	Std. Deviation	1,069		
	Minimum	2		
	Maximum	7		
	Range	5		
	Interquartile Range	2		
	Skewness	-,666	,319	
	Kurtosis	,917	,628	
	Autonomy2	Mean	2,50	,149
95% Confidence Interval for Mean		Lower Bound	2,20	
		Upper Bound	2,80	
5% Trimmed Mean		2,42		
Median		2,00		
Variance		1,236		
Std. Deviation		1,112		
Minimum		1		
Maximum		6		
Range		5		
Interquartile Range		1		
Skewness		1,276	,319	
Kurtosis		1,532	,628	
Autonomy3		Mean	5,13	,140
	95% Confidence Interval for Mean	Lower Bound	4,84	
		Upper Bound	5,41	
	5% Trimmed Mean	5,16		
	Median	5,00		
	Variance	1,093		
	Std. Deviation	1,046		
	Minimum	2		
	Maximum	7		
	Range	5		
	Interquartile Range	2		
	Skewness	-,456	,319	
	Kurtosis	,446	,628	

Figure D1

Boxplot of the perceived job autonomy items

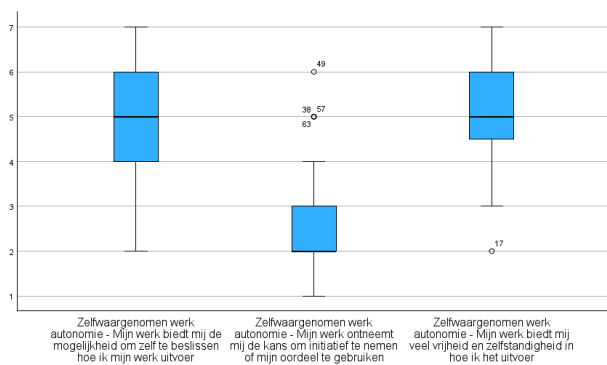


Table D3

Cronbach's alpha of the perceived job autonomy measure

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
,211	,238	3

Table D4**Item-Total Statistics**

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
Autonomy1	7,63	1,693	,433	,680	-,752 ^a
Autonomy2	10,18	4,077	-,283	,080	,903
Autonomy3	7,55	1,743	,436	,681	-,730 ^a

a. The value is negative due to a negative average covariance among items. This violates reliability model assumptions. You may want to check item codings.

Table D5

Cronbach's alpha of the open network measure with Autonomy2 reversed

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
,709	,715	3

Table D6

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
Autonomy1	10,6250	2,966	,673	,680	,429
Rev_Autonomy2	10,1786	4,077	,283	,080	,903
Autonomy3	10,5536	3,015	,682	,681	,422

Table D7**KMO and Bartlett's Test**

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		,551
Bartlett's Test of Sphericity	Approx. Chi-Square	64,764
	df	3
	Sig.	<,001

Table D8**Communalities**

	Initial	Extraction
Autonomy1	,680	,816
Rev_Autonomy2	,080	,089
Autonomy3	,681	,830

Extraction Method: Principal Axis Factoring.

Table D9**Factor Matrix^a**

	Factor 1
Autonomy1	,904
Rev_Autonomy2	,298
Autonomy3	,911

Extraction Method: Principal Axis Factoring.

a. 1 factors extracted. 9 iterations required.

Table D10

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		,500
Bartlett's Test of Sphericity	Approx. Chi-Square	60,682
	df	1
	Sig.	<,001

Table D11

Communalities

	Initial	Extraction
Autonomy1	,678	,823
Autonomy3	,678	,823

Extraction Method: Principal Axis Factoring.

Table D12

Total Variance Explained

Factor	Total	Initial Eigenvalues		Extraction Sums of Squared Loadings		
		% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	1,824	91,181	91,181	1,646	82,304	82,304
2	,176	8,819	100,000			

Extraction Method: Principal Axis Factoring.

Figure D2

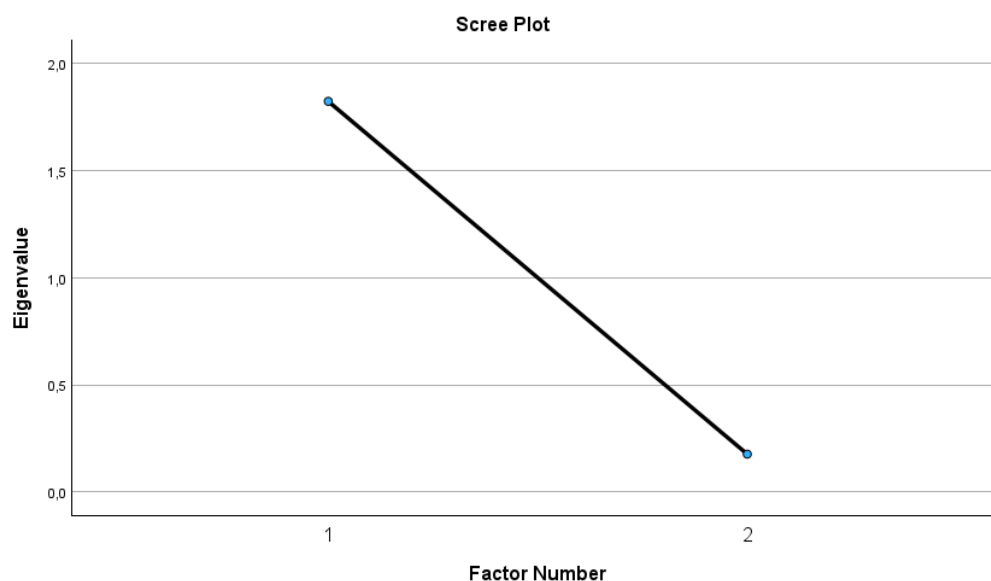


Table D13

Factor Matrix^a

	Factor 1
Autonomy1	,907
Autonomy3	,907

Extraction Method:
Principal Axis
Factoring.

a. 1 factors
extracted. 8
iterations
required.

Table D14

Cronbach's alpha of the perceived job autonomy measure without Rev_Autonomy2

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
,903	,903	2

Appendix E

Validation of the Perceived Transformational Leadership Measure

Descriptive and visual analyses indicated a normal distribution for the transformational leadership items, with only a few mild but valid outliers that were retained (Table E2 and figure E1). The scale showed excellent reliability with a Cronbach's value of .917, with all seven items contributing meaningfully (Tables E3 and E4). With a KMO of .840 and a significant Bartlett's test, the data was suitable for factor analysis (Table E5). The analysis confirmed a unidimensional structure for the scale, with communalities above .44 (mostly > .60), one dominant factor, and strong factor loadings, which lead to the retention of all seven items (Table E6-E8 and Figure E2).

Table E1

Perceived transformational leadership items (Carless et al., 2000)

Perceived transformational leadership
Communicates a clear and positive vision of the future (Vision)
Treats staff as individuals, supports and encourages their development (Staff development)
Gives encouragement and recognition to staff (Supportive Leadership)
Fosters trust, involvement and cooperation among team members (Empowerment)
Encourages thinking about problems in new ways and questions assumptions (Innovative thinking)
Is clear about his/her values and practises what he/she preaches (Lead by example)
Instills pride and respect in others and inspires me by being highly competent (Charisma)

Table E2

Descriptives			
	Statistic	Std. Error	
Leadership1	Mean	3.11	.121
	95% Confidence Interval for Mean	Lower Bound 2.86 Upper Bound 3.35	
	5% Trimmed Mean	3.12	
	Median	3.00	
	Variance	.825	
	Std. Deviation	.908	
	Minimum	1	
	Maximum	5	
	Range	4	
	Interquartile Range	2	
	Skewness	-.318	.319
	Kurtosis	-.087	.628
	Leadership2	Mean	3.52
95% Confidence Interval for Mean		Lower Bound 3.29 Upper Bound 3.75	
5% Trimmed Mean		3.60	
Median		4.00	
Variance		.727	
Std. Deviation		.853	
Minimum		1	
Maximum		5	
Range		4	
Interquartile Range		1	
Skewness		-1.427	.319
Kurtosis		1.425	.628
Leadership3		Mean	3.45
	95% Confidence Interval for Mean	Lower Bound 3.24 Upper Bound 3.66	
	5% Trimmed Mean	3.50	
	Median	4.00	
	Variance	.815	
	Std. Deviation	.784	
	Minimum	1	
	Maximum	5	
	Range	4	
	Interquartile Range	1	
	Skewness	-.989	.319
	Kurtosis	.659	.628
	Leadership4	Mean	3.38
95% Confidence Interval for Mean		Lower Bound 3.12 Upper Bound 3.60	
5% Trimmed Mean		3.38	
Median		4.00	
Variance		.816	
Std. Deviation		.903	
Minimum		1	
Maximum		5	
Range		4	
Interquartile Range		1	
Skewness		-.630	.319
Kurtosis		-.481	.628
Leadership5		Mean	3.11
	95% Confidence Interval for Mean	Lower Bound 2.84 Upper Bound 3.38	
	5% Trimmed Mean	3.13	
	Median	3.00	
	Variance	1.006	
	Std. Deviation	1.003	
	Minimum	1	
	Maximum	5	
	Range	4	
	Interquartile Range	2	
	Skewness	-.334	.319
	Kurtosis	-.772	.628
	Leadership6	Mean	3.23
95% Confidence Interval for Mean		Lower Bound 2.96 Upper Bound 3.50	
5% Trimmed Mean		3.31	
Median		4.00	
Variance		1.019	
Std. Deviation		1.009	
Minimum		1	
Maximum		4	
Range		3	
Interquartile Range		1	
Skewness		-1.151	.319
Kurtosis		.175	.628
Leadership7		Mean	3.13
	95% Confidence Interval for Mean	Lower Bound 2.89 Upper Bound 3.36	
	5% Trimmed Mean	3.19	
	Median	3.00	
	Variance	.802	
	Std. Deviation	.896	
	Minimum	1	
	Maximum	4	
	Range	3	
	Interquartile Range	1	
	Skewness	-.726	.319
	Kurtosis	-.314	.628

Figure E1

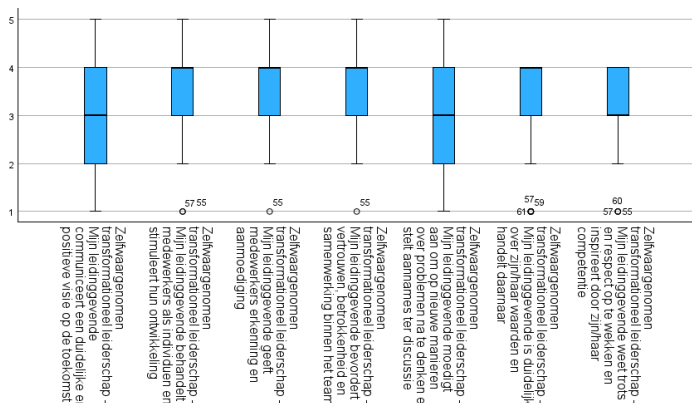


Table E3

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
,917	,917	7

Table E4

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
Leadership1	19,79	19,990	,776	,677	,901
Leadership2	19,38	20,966	,695	,505	,909
Leadership3	19,45	21,852	,634	,530	,915
Leadership4	19,54	20,071	,770	,672	,901
Leadership5	19,79	19,335	,768	,692	,902
Leadership6	19,66	19,501	,740	,694	,905
Leadership7	19,77	19,672	,836	,798	,895

Table E5

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		,840
Bartlett's Test of Sphericity	Approx. Chi-Square	262,301
	df	21
	Sig.	<,001

Table E6

Communalities

	Initial	Extraction
Leadership1	,677	,655
Leadership2	,505	,527
Leadership3	,530	,442
Leadership4	,672	,656
Leadership5	,692	,656
Leadership6	,694	,611
Leadership7	,798	,771

Extraction Method: Principal Axis Factoring.

Table E7

Factor	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	4,687	66,961	66,961	4,318	61,679	61,679
2	,699	9,979	76,940			
3	,508	7,259	84,198			
4	,415	5,930	90,128			
5	,361	5,152	95,280			
6	,208	2,969	98,249			
7	,123	1,751	100,000			

Extraction Method: Principal Axis Factoring.

Figure E2

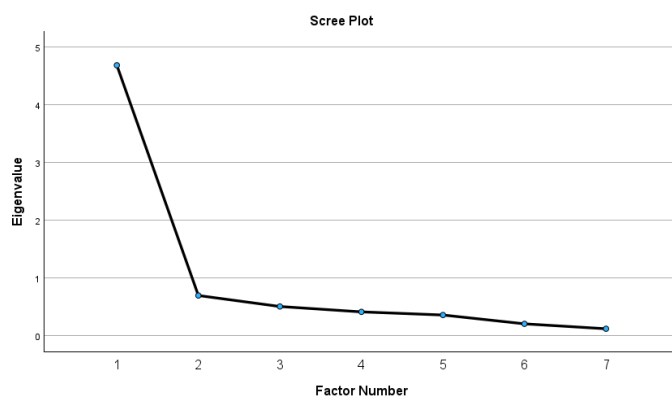


Table E8

Factor Matrix ^a	
	Factor 1
Leadership1	,809
Leadership2	,726
Leadership3	,665
Leadership4	,810
Leadership5	,810
Leadership6	,781
Leadership7	,878

Extraction Method:
Principal Axis Factoring.

a. 1 factors extracted.
4 iterations
required.

Appendix F**Mean construct scores****Table F1**

Descriptive Statistics						
	N	Range	Minimum	Maximum	Mean	Std. Deviation
Mean_Creativity	56	4,67	2,33	7,00	4,0952	1,04970
Mean_Network	56	4,00	1,00	5,00	2,6964	,87911
Mean_Openness	56	3,00	2,00	5,00	3,8869	,65836
Mean_Autonomy	56	5,00	2,00	7,00	5,0893	1,00953
Mean_Leadership	56	3,43	1,00	4,43	3,2704	,74389
Valid N (listwise)	56					

Appendix G

Necessary Condition Analysis with Open Network

Table G1

Results of the NCA for the entire dataset

	CE-FDH	CR-FDH
Ceiling zone	2.667	1.779
Effect size	0.143	0.095
# above	0	3
c-accuracy	100%	94.6%
Fit	100%	66.7%
p-value	0.388	0.361
p-accuracy	0.01	0.009

Table G2

Influential outliers in the dataset

Respondent	Effect size original	Effect size without	Difference absolute	Difference relative (%)	Ceiling outlier	Scope outlier
55	0.14	0.07	-0.07	-52.3%	✓	✓
4	0.14	0.18	+0.04	+25.0%	✓	

44	0.14	0.16	+0.01	+9.1%		✓
7	0.14	0.15	+0.01	+7.7%		✓

Table G3

Results of the NCA without respondent 55

	CE-FDH	CR-FDH
Ceiling zone	1.000	0.500
Effect size	0.068	0.034
# above	0	0
C-accuracy	100%	100%
Fit	100%	50.0%
p-value	0.431	0.441
p-accuracy	0.003	0.003

Table G4

Influential outliers without respondent 55

Outliers	Eff.or	Eff.nw	Dif.abs	Dif.rel	Ceiling	Scope
4	0.07	0.11	0.04	66.7%	X	
7	0.07	0.08	0.01	10.0%		X
44	0.07	0.07	0.01	9.1%		X

Table G5

Results of the NCA without respondent 4

	CE-FDH	CR-FDH
Ceiling zone	1.667	0.833
Effect size	0.114	0.057
# Above	0	0

C-Accuracy	100%	100%
Fit	100%	50.0%
p-value	0.143	0.212
p-accuracy	0.002	0.003

Table G6

Result of the NCA (0-25% working from home)

	CE-FDH	CR-FDH
Ceiling zone	2.667	1.779
Effect size	0.182	0.121
# above	0	2
c-accuracy	100%	91.3%
Fit	100%	66.7%
p-value	0.453	0.421
p-accuracy	0.003	0.003

Table G7

Influential outliers

Respondent	Effect size original	Effect size without	Difference absolute	Difference relative (%)	Ceiling outlier	Scope outlier
19	0.18	0.3	0.11	62.5	X	

23	0.18	0.09	-0.09	-50.0	X	X
17	0.18	0.25	0.07	37.5		X
2	0.18	0.23	0.05	25.0	X	

Table G8

Result of the NCA without respondent 19 (0-25% working from home)

	CE-FDH	CR-FDH
Ceiling zone	4.333	2.807
Effect size	0.295	0.191
# above	0	1
c-accuracy	100%	95.5%
Fit	100%	64.8%
p-value	0.182	0.246
p-accuracy	0.002	0.003

Table G9

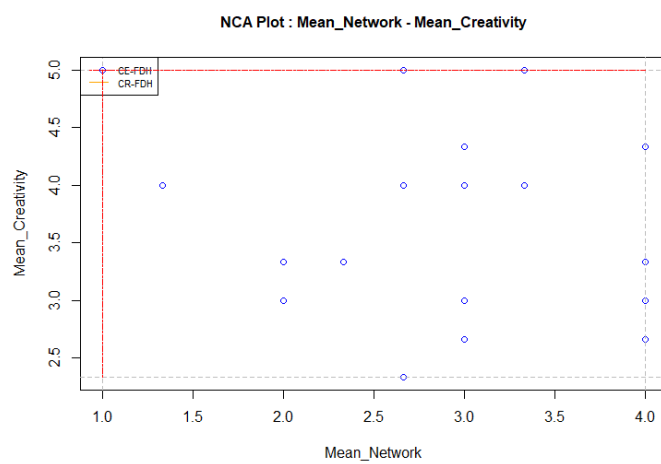
Result of the NCA (25-50% working from home)

	CE-FDH	CR-FDH
Ceiling zone	0.000	0.000

Effect size	0.000	0.000
# above	0	0
c-accuracy	100%	100%
Fit	100%	NA
p-value	1.000	1.000
p-accuracy	0.000	0.000

Figure G1

Scatterplot



Appendix H

Necessary Condition Analysis with Openness to Experience

Table H1

Results of the NCA for the entire dataset

	CE-FDH	CR-FDH
Ceiling zone	2.556	1.948
Effect size	0.183	0.139
# above	0	2
C-Accuracy	100%	96.4%
Fit	100%	76.2%
p-value	0.792	0.722
p-accuracy	0.003	0.003

Table H2

Influential outliers

Respondent	Effect size original	Effect size without	Difference absolute	Difference relative (%)	Ceiling outlier	Scope outlier
22	0.18	0.11	-0.08	-41.3	X	X
55	0.18	0.11	-0.07	-39.1	X	X

28	0.18	0.23	+0.05	+26.1	X	
51	0.18	0.22	+0.04	+21.7	X	
7	0.18	0.20	+0.01	+7.7		X

Table H3

Results of the NCA (0-25% working from home)

	CE-FDH	CR-FDH
Ceiling zone	4.556	3.301
Effect size	0.427	0.310
# above	0	2
c-accuracy	100%	91.3%
Fit	100%	72.5%
p-value	0.340	0.345
p-accuracy	0.003	0.003

Table H4

Influential outliers

Respondent	Effect size original	Effect size without	Difference absolute	Difference relative (%)	Ceiling outlier	Scope outlier

19	0.18	0.30	0.11	62.5	X	
23	0.18	0.09	-0.09	-50.0	X	X
17	0.18	0.25	0.07	37.5		X
2	0.18	0.23	0.05	25.0	X	

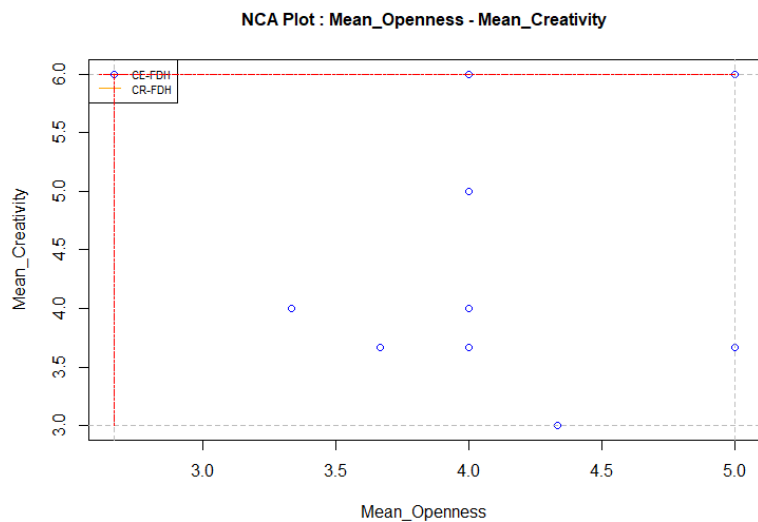
Table H5

Results of the NCA without respondent 19 (-025% working from home)

	CE-FDH	CR-FDH
Ceiling zone	0.000	0.000
Effect size	0.000	0.000
# above	0	0
c-accuracy	100%	100%
Fit	100%	NA
p-value	1.000	1.000
p-accuracy	0.000	0.000

Figure H1

Scatterplot

**Table H6**

Results of the NCA (25-50% working from home)

	CE-FDH	CR-FDH
Ceiling zone	0.000	0.000
Effect size	0.000	0.000
# above	0	0
c-accuracy	100%	100%
Fit	100%	NA
p-value	1.000	1.000
p-accuracy	0.000	0.000

Figure H2

Scatterplot

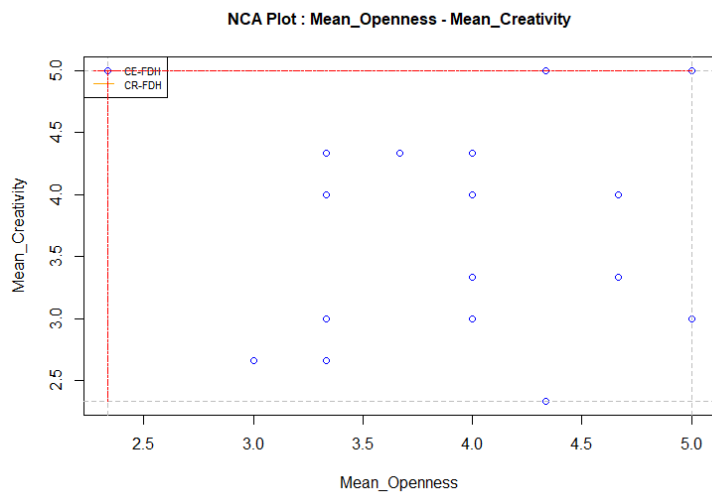
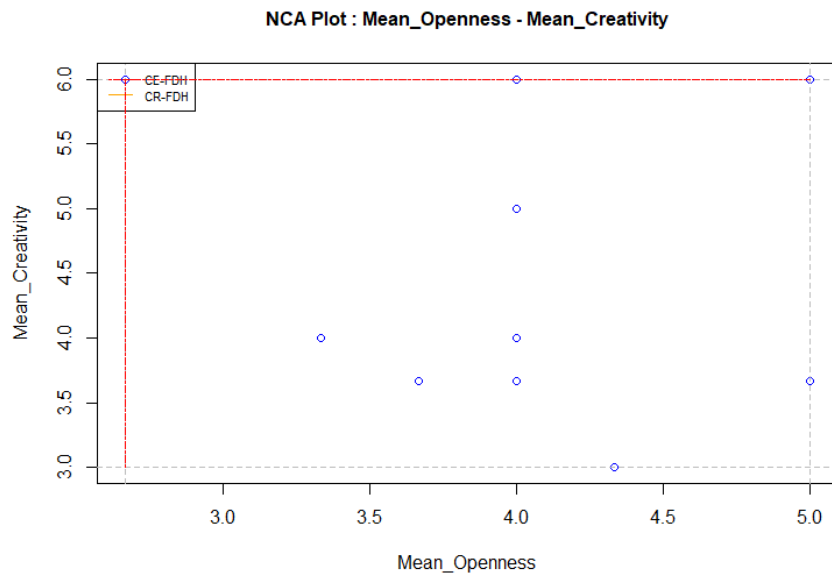


Table H7

Results of the NCA 50-75% working from home)

	CE-FDH	CR-FDH
Ceiling zone	0.000	0.000
Effect size	0.000	0.000
# above	0	0
c-accuracy	100%	100%
Fit	100%	NA
p-value	1.000	1.000
p-accuracy	0.000	0.000

Figure H3



Appendix I

Necessary Condition Analysis with Perceived Job Autonomy

Table I1

Results of the NCA for the entire dataset

	CE-FDH	CR-FDH
Ceiling zone	8.333	7.225
Effect size	0.357	0.310
# above	0	2
c-accuracy	100%	96.4%
Fit	100%	86.7%
p-value	0.155	0.063
p-accuracy	0.002	0.002

Table I2

Influential outliers

Respondent	Effect size original	Effect size without	Difference absolute	Difference relative (%)	Ceiling outlier	Scope outlier
55	0.36	0.18	-0.18	-49.1	X	X
17	0.36	0.21	-0.14	-40.0	X	X

3	0.36	0.49	0.13	36.0	X	
7	0.36	0.38	0.03	7.7		X

Table I3

Results of the NCA without respondent 55

	CE-FDH	CR-FDH
Ceiling zone	3.333	1.667
Effect size	0.182	0.091
# above	0	0
c-accuracy	100%	100%
Fit	100%	50.0%
p-value	0.555	0.638
p-accuracy	0.003	0.003

Table I4

Results of the NCA without respondent 17

	CE-FDH	CR-FDH
Ceiling zone	4.000	2.000
Effect size	0.214	0.107

# above	0	0
c-accuracy	100%	100%
Fit	100%	50.0%
p-value	0.474	0.697
p-accuracy	0.003	0.003

Table I5

Results of the NCA (25-50% working from home)

	CE-FDH	CR-FDH
Ceiling zone	4.333	3.070
Effect size	0.325	0.230
# above	0	2
c-accuracy	100%	90.5%
Fit	100%	70.9%
p-value	0.293	0.214
p-accuracy	0.003	0.003

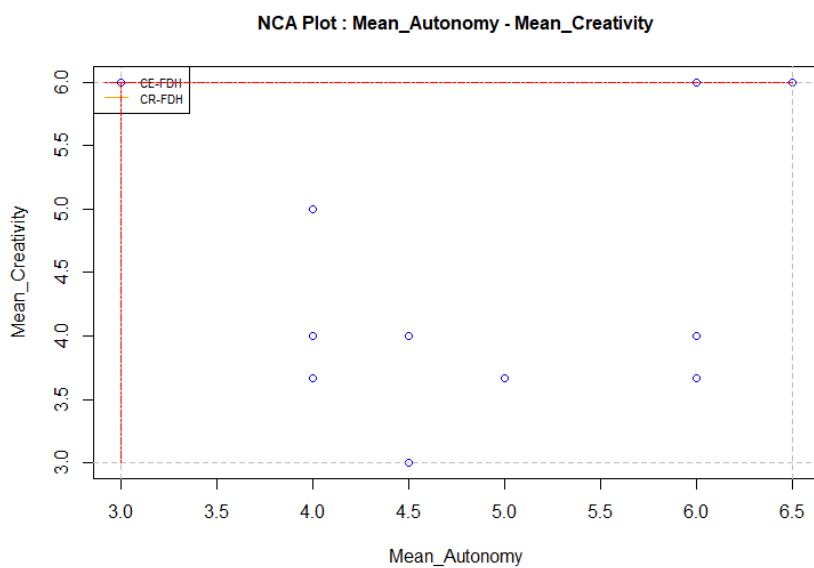
Table I6

Results of the NCA (50-75% working from home)

	CE-FDH	CR-FDH
Ceiling zone	0.000	0.000
Effect size	0.000	0.000
# above	0	0
c-accuracy	100%	100%
Fit	100%	NA
p-value	1.000	1.000
p-accuracy	0.000	0.000

Figure I1

Scatterplot



Appendix J

Validation of the Creativity and Perceived Job Autonomy Measure without Respondent 3

The descriptives of the datasets are shown in Tables J1 and J2.

The Cronbach's alpha of creativity was .883, which is far above the threshold of .70 (Table J3). Although it is already way above the threshold, deleting any item wouldn't lead to an increase in the value (Table J4). Therefore, the items were deemed as reliable and were retained.

The initial Cronbach's alpha for autonomy was very low (.192; Table J5), but improved to .698 after reverse-coding the negatively worded Autonomy2 (Table J6). Since deleting Rev_Autonomy2 raised alpha further to .895 (Table J7 and J8), it was removed to ensure construct reliability; no further improvement was possible (Table J9). As seen before, the same applied to the dataset including respondent 3, where Rev_Autonomy2 was also removed for the same reason.

Factor analysis confirmed construct validity for both creativity and autonomy: creativity showed good sampling adequacy, high communalities, strong factor loadings, and a clear one-factor structure explaining over 60% of the variance (Tables J10-I13). Autonomy showed an acceptable KMO (.50), significant Bartlett's test, high communalities, strong loadings, and one dominant factor (Tables J14-J17).

Overall, considering Cronbach's alpha and the factor analyses, both constructs with the dataset without respondent 3 are deemed reliable and valid.

Table J1

Descriptive statistics for the creativity measure

Descriptive Statistics					
	N	Minimum	Maximum	Mean	Std. Deviation
Creativity1	55	2	7	4,05	1,145
Creativity2	55	3	7	4,27	,990
Creativity3	55	2	7	3,85	1,268
Valid N (listwise)	55				

Table J2*Descriptive statistics for the autonomy measure*

Descriptive Statistics					
	N	Minimum	Maximum	Mean	Std. Deviation
Autonomy1	55	2	7	5,09	1,041
Autonomy2	55	1	6	2,49	1,120
Autonomy3	55	2	7	5,16	1,014
Valid N (listwise)	55				

Table J3*Cronbach's alpha for the creativity measure*

Reliability Statistics		
Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
,883	,888	3

Table J4

Item-Total Statistics					
	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
Creativity1	8,13	4,335	,805	,647	,806
Creativity2	7,91	5,121	,755	,573	,860
Creativity3	8,33	3,928	,786	,621	,833

Table J5*Cronbach's alpha for the autonomy measure*

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
,192	,237	3

Table J6

Cronbach's alpha for the autonomy measure after reversing Autonomy2

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
,698	,707	3

Table J7**Item-Total Statistics**

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
Autonomy1	10,6727	2,891	,655	,658	,421
Rev_Autonomy2	10,2545	3,823	,278	,077	,895
Autonomy3	10,6000	2,948	,666	,659	,413

Table J8

Cronbach's alpha of the autonomy measure after deleting Rev_Autonomy2

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
,895	,895	2

Table J9

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
Autonomy1	5,16	1,028	,810	,656	.
Autonomy3	5,09	1,084	,810	,656	.

Table J10

KMO and Bartlett's test for the creativity measure

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		,743
Bartlett's Test of Sphericity	Approx. Chi-Square	88,957
	df	3
	Sig.	<,001

Table J11

Communalities

	Initial	Extraction
Creativity1	,647	,784
Creativity2	,573	,664
Creativity3	,621	,731

Extraction Method: Principal Axis Factoring.

Table J12

Total Variance Explained

Factor	Total	Initial Eigenvalues		Extraction Sums of Squared Loadings		
		% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	2,451	81,690	81,690	2,179	72,643	72,643
2	,310	10,348	92,038			
3	,239	7,962	100,000			

Extraction Method: Principal Axis Factoring.

Table J13

Factor Matrix^a

	Factor 1
Creativity1	,885
Creativity2	,815
Creativity3	,855

Extraction Method:
Principal Axis
Factoring.

a. 1 factors
extracted. 8
iterations
required.

Table J14

KMO and Bartlett's test for the autonomy measure

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		,500
Bartlett's Test of Sphericity	Approx. Chi-Square	56,032
	df	1
	Sig.	<,001

Table J15**Communalities**

	Initial	Extraction
Autonomy1	,656	,809
Autonomy3	,656	,809

Extraction Method: Principal Axis
Factoring.

Table J16**Total Variance Explained**

Factor	Total	Initial Eigenvalues		Extraction Sums of Squared Loadings		
		% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	1,810	90,499	90,499	1,619	80,937	80,937
2	,190	9,501	100,000			

Extraction Method: Principal Axis Factoring.

Table J17

Factor Matrix^a

	Factor 1
Autonomy1	,900
Autonomy3	,900

Extraction Method:
Principal Axis
Factoring.

- a. 1 factors
extracted. 8
iterations
required.

Appendix K

Necessary Condition Analysis with Perceived Transformational Leadership

Table J1

Results of the NCA for the entire dataset

	CE-FDH	CR-FDH
Ceiling zone	0.000	0.000
Effect size	0.000	0.000
# above	0	0
c-accuracy	100%	100%
Fit	100%	NA
p-value	1.000	1.000
p-accuracy	0.000	0.000

Figure K1

Scatterplot

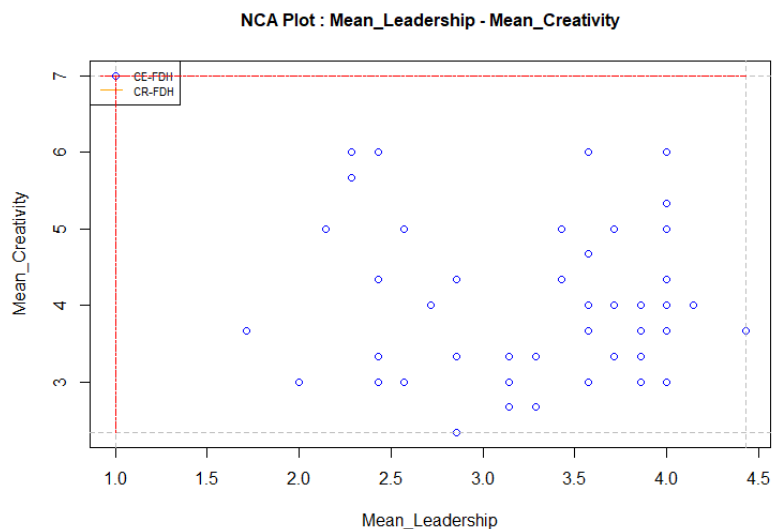


Table K2

Results of the NCA (0-25% working from home)

	CE-FDH	CR-FDH
Ceiling zone	0.000	0.000
Effect size	0.000	0.000
# above	0	0
c-accuracy	100%	100%
Fit	100%	NA
p-value	1.000	1.000
p-accuracy	0.000	0.000

Table K3

Results of the NCA (25-50% working from home)

	CE-FDH	CR-FDH
Ceiling zone	0.286	0.143
Effect size	0.054	0.027
# above	0	0
c-accuracy	100%	100%
Fit	100%	50.0%
p-value	0.785	0.785
p-accuracy	0.003	0.003

Table K4

Results of the NCA (50-75% working from home)

	CE-FDH	CR-FDH
Ceiling zone	1.333	0.667
Effect size	0.183	0.092
# above	0	0
c-accuracy	100%	100%
Fit	100%	50.0%
p-value	0.607	0.614
p-accuracy	0.003	0.003