Exploring SME’s behavioural changes resulting from innovation policy: the effect of receiving a subsidy on intrapreneurship

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\textbf{ABSTRACT}

Intrapreneurship is critical for small to medium-sized enterprises (SMEs), in that it enhances innovation and organizational performance. This study details how intrapreneurship develops in subsidized relative to unsubsidized SMEs. We build on behavioural additionality research, as these studies examine changes in firm behaviour that occur after the firm receives public support. Prior studies focus on the effect on external collaboration, but subsidies also can lead to organizational learning and upgraded competencies, implying the potential for changes to organizational routines. Our test of the behavioural additionality effect relies on an original longitudinal data set involving manufacturing SMEs in the Dutch province of Limburg. The data analysis combines propensity score matching with a difference-in-difference approach, which reveals a significantly higher increase in one aspect of intrapreneurship, namely strategic renewal behaviour, among SMEs that receive an innovation subsidy. The findings advance understanding of intrapreneurship and behavioural additionality effects and provide policy makers with new evidence of the added value of subsidy programmes.

\textbf{Introduction}

As the number of innovation support programmes created by governments to drive economic growth and development has been growing (Cunningham and Link 2015, 2016), researchers and policy makers increasingly seek empirical evidence about whether this type of public money is well spent (Clarysse, Wright, and Mustar 2009). Three types of research approaches prevail to evaluate the effects of innovation subsidies, namely input, output and behavioural additionality. Input additionality studies examine whether innovation subsidies boost private R&D or act as a substitute for it (Dimos et al. 2022; Dimos and Pugh 2016), while output additionality studies instead examine R&D outputs such as patents or revenues derived from a new product or service, which would not have been achieved without the subsidy (Georgihiou 2002). Studies applying the behavioural additionality perspective aim to identify changes in an organization’s short- and long-term behaviour resulting from the innovation subsidy (Buisseret, Cameron, and Georgiou 1995; Chávez and Sergio 2011). Such studies on changes in organizational behaviour are less common than studies applying the other two perspectives (Cerulli, Gabriele, and Poti 2016). The evidence is also largely anecdotal (Clarysse, Wright, and Mustar 2009; Falk 2007), mainly due to the limited availability of useful data and because intangible behavioural changes resulting from an innovation subsidy are difficult to
measure (Falk 2007). Nevertheless, behavioural additiveness effects potentially exert the most durable impact on organizations though (Davenport, Grimes, and Davies 1998).

Currently, behavioural additiveness studies mainly focus on collaboration behaviour (Cunningham and Gök 2012) and reveal that innovation subsidies stimulate external collaboration (e.g. Caloffi, Rossi, and Russo 2015; Chávez and Sergio 2011), measured as a change in the resources available for collaboration (input) or the number of firms with which the organization collaborates (output). Gök and Edler (2012) assert that a true understanding of behavioural additiveness also requires consideration of its internal dynamics. For example, innovation subsidies can lead to upgraded internal competencies and routines or induce changes in senior managers’ innovation-oriented attitudes (Antonioli, Marzucchi, and Montresor 2014; Chapman and Hewitt-Dundas 2018).

However, detailed knowledge about which internal competencies or processes improve is lacking. Moreover, the behavioural additiveness perspective seems to be neglected in the innovation support programmes for SMEs altogether (Radicic et al. 2015).

This study aims to extend knowledge on this perspective by examining the effect of innovation subsidies on one such internal competency, namely, intrapreneurship within SMEs. Following Neessen et al. (2019) we define intrapreneurship as ‘[…] a process whereby employee(s) recognize and exploit opportunities by being innovative, proactive and by taking risks, in order for the organization to create new products, processes and services, initiate self-renewal or venture new businesses to enhance the competitiveness and performance of the organization’ (Neessen et al. 2019, 551). Intrapreneurship has been conceptualized as a two-dimensional construct consisting of an employee’s venture behaviour and strategic renewal behaviour (Gawke, Gorgievska, and Bakker 2019). Research emphasizes the important role of intrapreneurial behaviour in organizations. Employees need to become ‘innovators’ and differentiators” (Bowen 2016) to be able to adapt to and shape the changing business environment (Teece 2010) and drive ideas for new products, processes or services (Neessen et al. 2019). By adopting intrapreneurial behaviour, employees can impact not only their organization’s strategic direction (Hart 1992; Peters and Waterman 1984) but also its innovation and organizational performance (Fallnhofer 2017; Neessen et al. 2019; Sieger, Zellweger, and Aquino 2013). As a result, intrapreneurship has become crucial for organizations to survive and maintain their competitive advantage (Morris, Webb, and Franklin 2011). We posit that intrapreneurial behaviour of employees may be more critical to the success of small to medium-sized enterprises (SMEs), relative to large organizations, because a key challenge for smaller firms is to continuously adapt and renew themselves in pursuing growth opportunities (Bierwerth et al. 2015). Moreover, SMEs must fully exploit their workforce resources and rely on their staff to perform learning, innovation and creativity tasks (Castrogiovanni 2011; Rohlf 2018). Furthermore, SMEs are important engines of economic growth, employment and innovation, so for these reasons we conduct our research in an SME context (Radas and Božić 2009). We set out to answer the following research question: What is the effect of receiving an innovation subsidy on intrapreneurship’s subdimensions employee venture behaviour and strategic renewal behaviour in SMEs?

Our findings, obtained from original longitudinal data of a Dutch innovation subsidy programme for SMEs, indicate that innovation subsidies have a positive influence on one aspect of intrapreneurship, namely strategic renewal behaviour. Thereby, this study makes several contributions to the literature on intrapreneurship and innovation subsidy effects. First, we advance knowledge of what drives intrapreneurship in SMEs. In line with Neessen et al. (2019), we specify that access to innovation subsidies can provide employees with the financial resources and managerial support to engage in the strategic renewal dimension of intrapreneurial behaviour. Secondly, we respond to calls by Autio, Kanninen, and Gustafsson (2008), Catozella and Vivarelli (2016) and Neessen et al. (2019) for longitudinal studies, preferably using repeated measures from the same projects, to determine the temporal dynamics of innovation subsidy effects. Our unique data set captures these dynamics by combining propensity score matching with a difference-in-difference approach. By doing so, we are the first to apply a robust, econometric evaluation method to investigate behavioural additivity effects on a specific organizational routine in SMEs. Third, we advance...
behavioural additionality research by addressing two of its fundamental issues, namely, investigating its effects in the neglected SME-context (Radicic et al. 2015) and the proper unit of analysis, which is organizational routines (Gök and Edler 2012). By investigating intrapreneurship, which exemplifies an organizational routine, we shed new light on the internal organizational effects of behavioural additionality.

In the next section, we review the existing literature and develop our hypotheses. After the description of the subsidy programme, the sample and measures, we detail our methodology and results. We then discuss the findings and implications of our research. Finally, we suggest directions for further research.

**Input, output or behavioural additionality research**

In most European countries, public support organizations seek opportunities to stimulate innovation by private firms. This has spurred interest among researchers on how to measure the returns to these public innovation investments (Georghiou and Roessner 2000). We present various approaches to measure these returns in more detail, and explain our focus on one organizational routine, intrapreneurship, as a form of behavioural additionality.

As a first research approach, input additionality deals with the question of whether innovation subsidies boost or replace R&D investments by the receiving companies (Clarysse, Wright, and Mustar 2009; Georghiou 2002). It is the most traditional and widely used concept to evaluate the effectiveness of innovation subsidies; it relates closely to the crowding-out/crowding-in debate (Clarysse, Wright, and Mustar 2009). In input additionality terms, an instrument is effective if every Euro of government support leads to at least one Euro of private, organizational funds invested (Georghiou 2002). Yet public funds also might create inefficiencies (e.g. higher salaries for researchers) or substitute for R&D that would have taken place without the subsidy (Clarysse, Wright, and Mustar 2009). If public support substitutes for private investments, managers and public policy makers need to understand why; otherwise, their designs of public funding programmes might be self-defeating. If they are complements though, these actors need to understand the leveraging effect so that they can take optimal advantage of it (Brooks 2000). In addition, substantial empirical evidence already suggests a positive effect of public subsidies on short-term input additionality measures. For example, two meta-regression analyses (Dimos et al. 2022; Dimos and Pugh 2016) have concluded that funded firms are significantly more active in R&D than are non-funded firms. Czarnitzki and Licht (2006) offer similar findings when they address input additionality as R&D and innovation expenditures. However, an important concern associated with using input additionality to evaluate innovation subsidies is that no direct link is possible between innovation input and output. It is questionable whether input additionality obviously translates into innovative output and economic welfare (Clarysse, Wright, and Mustar 2009).

Output additionality offers another method to evaluate the effect of subsidy programmes. Georghiou (2002) defines it as the proportion of outputs from the R&D process which would not have been achieved without public support. Whereas input additionality deals with the degree to which public efforts activate additional R&D efforts by the private firm, output additionality focuses on how much additional innovation output a subsidy has created. This metric can be measured by direct firm-level innovations (patents, papers, prototypes) or as indirect firm-level innovation outputs, such as new products or the application of new processes and services (Clarysse, Wright, and Mustar 2009). More general firm performance indicators (turnover, profit, productivity) also might reveal output effects of R&D support (Clarysse, Wright, and Mustar 2009). In output additionality terms, empirical evidence again confirms a positive effect of public support on innovation performance. For example, Czarnitzki and Hussinger (2004) and Czarnitzki and Licht (2006) identify substantial additionality in public R&D grants pertaining to innovation outputs (i.e. patents and applications). Hewitt-Dundas and Roper (2010) suggest that innovation subsidies encourage firms to initiate new projects and improve the quality and sophistication of their innovation activities.
However, due to within- and between-firm spill-overs, it is difficult to specify a one-on-one relationship between an innovation subsidy and its output (Clarysse, Wright, and Mustar 2009). In settings marked by substantial spill-overs, non-supported firms reap the benefits of a public subsidy, which leads to underestimates of the effect of the programme in comparisons of supported versus non-supported firms (Klette, Møen, and Griliches 2000).

As input and output additionality studies do not necessarily shed light on how public subsidies lead to additionality, authors (Georghiou and Roessner 2000; Falk 2007) increasingly call for complementary methods that capture the noneconomic benefits of subsidies more comprehensively. The notion of behavioural additionality, introduced by Buisseret, Cameron, and Georghiou (1995), pertains to firm behaviour that results from public support. According to Falk (2007), few studies of behavioural additionality use an econometric approach, likely because of the difficulty of measuring such behaviour.

As the overview of empirical research in Table 1 indicates, with only seventeen studies, evidence of behavioural additionality remains limited. No more than three studies take a longitudinal approach. Furthermore, only four studies address an SME-specific context. Rather, most existing research focuses on external cooperation behaviour or the network dimension to assess organizational change and behavioural additionality (e.g. Busom and Fernández-Ribas 2008; Cerulli, Gabriele, and Poti 2016; Clarysse, Wright, and Mustar 2009; Falk 2007). These studies measure collaboration behaviour as changes in the resources available for collaboration or in the number of firms with which the organization collaborates. They reveal that publicly funded firms engage more actively in collaboration with other firms and public research organizations, both during and after the project term (Georghiou and Clarysse 2006). In a similar vein, Fier, Aschhoff, and Löhlein (2006) uncover significant changes in the patterns of technological collaboration; they report that new business and science collaborations remain durable, and innovation subsidies stimulate firms’ search for new partners. Only four of the seventeen studies in Table 1 report evidence of internal behavioural additionality effects. Specifically, Hsu, Juinn Horng, and Chih Hsueh (2009) claim that innovation subsidies cause changes in a firm’s strategy. Chapman and Hewitt-Dundas (2018) argue that subsidies can induce small positive changes in managerial attitudes towards innovation. Subsidies also might stimulate organizational learning, thereby improving organizational competencies or routines (Antonioli, Marzucchi, and Montresor 2014; Autio, Kanninen, and Gustafsson 2008). However, we lack detailed knowledge about precisely which internal organizational routines improve after receiving a subsidy (Gök 2010). This study aims to shed light on this by investigating the effect of an innovation subsidy on intrapreneurship in SMEs.

**Intrapreneurship and innovation subsidies**

Organizational routines are repetitive, recognizable patterns of interdependent behaviour carried out by multiple actors (Feldman and Pentland 2003), and one such important routine is intrapreneurship. Intrapreneurial behaviours can originate from individual employees bottom-up (Hayton and Kelley 2006; Kuratko and Montagno 1989; Neessen et al. 2019) and generate initiatives that affect the (innovation) performance of teams and organizations (Fellnhofer 2017; Maritz 2010; Moriano et al. 2014). Gawke, Gorgievski, and Bakker (2019) conceptualize intrapreneurship as behaviours that revolve around venture creation and strategic renewal. Employee venture behaviour involves an employee’s agentic and anticipatory behaviours with the goal of creating new business for their organization (Gerards, van Wetten, and van Sambeek 2021). Strategic renewal behaviour entails behaviours that aim to increase an organization’s ability to react to internal and external developments (Gawke, Gorgievski, and Bakker 2019).

Employees can be stimulated to adopt more intrapreneurial behaviour in multiple ways, namely by providing resources, managerial support, autonomy and rewards for intrapreneurial activities and by adopting the optimal organizational structure (Neessen et al. 2019). We argue that innovation subsidies can enhance intrapreneurship by increasing both the amount of
Table 1. Empirical investigations of behavioural additionality.

| Authors (year) | Sample | Longitudinal approach | Support for internal behavioural additionality effects | Findings |
|----------------|--------|-----------------------|-------------------------------------------------------|----------|
| Chávez and Sergio (2011) | 3249* Spanish manufacturing firms | | | Regional subsidies foster cooperation with universities and technological centres for organizations not engaged in innovation collaboration; national subsidies stimulate cooperation with universities and technological centres for organizations already engaged in innovation collaboration. |
| Ahn, Lee, and Mortara (2020) | 489 Korean manufacturing firms | | | R&D subsidies stimulate firms to choose partners more adventurously, by going outside the traditional value chains and regional boundaries. The impact of subsidies on innovation collaboration follows an inverted U-shaped curve: The impact in highly funded firms is smaller than in firms that receive a more modest amount. |
| Antonioli, Marzucchi, and Montresor (2014) | 408 Italian manufacturing firms | | X | Innovation subsidies can make firms more active as learning organizations, allowing them to be more efficient in terms of extending and/or upgrading competencies or routines. Innovation cooperation with other business partners remains unaffected in most cases. |
| Autio, Kanninen, and Gustafsson (2008) | 66 Finnish firms | | | A shared community identity among participants of collaborative innovation programs is positively associated with organizational learning (boost of technological learning and distinctiveness, market learning and internationalization learning). |
| Berrutti and Bianchi (2020) | 835 Uruguayan firms | X | 2001–2015 | Public support in regions with a traditionally low innovative pattern has neither a pronounced impact on a firm’s innovation behaviour in terms of process innovations or training activities, nor on its interactions with research centres or other firms. |
| Busom and Fernández-Ribas (2008) | 716 Spanish manufacturing firms | | | Participation in an R&D program increases the probability that organizations cooperate with a public research organization and, to a lesser extent, the probability of partnerships with customers and suppliers. |
| Cerulli, Gabriele, and Poti (2016) | 1106 Italian firms | X | 1998–2000 and 2002–2004 | Participation in innovation policy programs has a strong, positive effect on cooperation. Cooperation above a certain threshold value can reinforce the relationship between input additionality and product innovation propensity. |
| Chapman and Hewitt-Dundas (2018) | 620 United Kingdom SMEs | | X | Innovation vouchers induce small positive changes in senior managers’ innovation-oriented attitudes. |
| Clarysse, Wright, and Mustar (2009) | 276 Belgian firms | | | Learning as a result of receiving an innovation subsidy leads to increased behavioural additionality. The learning effects decrease with the number of subsidized projects undertaken by the company. Additionalities start to accrue already during the application process. Different forms of innovation subsidies are necessary to ensure behavioural additionality effects such as more cooperation. |
| Falk (2007) | 1298 Austrian firms | | | |

(Continued)
Table 1. (Continued).

| Authors (year)                      | Sample                  | Longitudinal approach | Support for internal behavioural additonality effects | Findings                                                                                                                                 |
|------------------------------------|-------------------------|-----------------------|-------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------|
| Hsu, Juinn Horng, and Chih Hsueh (2009) | 216 Taiwanese firms     | X                     | Behavioural additonality can be classified as project enlargement, strategy formulation, cost effectiveness and commercialization behaviour. |
| Kim (2021)                         | 7217 Korean manufacturing SMEs |                       | Independent SMEs benefit more from innovation subsidies, since innovation subsidies for SMEs that depend on large firms and primary subcontractors of large firms have a smaller effect on boosting knowledge-generating activities through external partnerships and alliances. |
| Neicu, Teirlinck & Kelchtermans (2016) | 127 Belgian firms       |                       | Innovation subsidies induce tax credit users to focus more on research relative to development and to accelerate the execution of R&D projects. Firms scale up their current R&D and initiate additional projects. |
| Orlic, Radicic, and Balavac (2019)  | 141–157** SMEs from 6 Western Balkan countries |                       | Innovation subsidies do not promote cooperation with customers and suppliers, marginally promotes cooperation with competitors and universities, and strongly promotes cooperation with private-sector consultants and government institutions. |
| Radicic, Pugh, and Douglas (2020)   | 312 manufacturing SMEs from 7 EU regions |                       | Innovation support programs for manufacturing SMEs do not promote cooperation with competitors, marginally promote cooperation with customers and suppliers and strongly promote cooperation with external knowledge providers (i.e. private sector consultants, government research centres, public research centres and higher education institutions). |
| Rossi, Caloffi & Russo (2016)      | 819 Italian firms       | X                     | The imposition of policy requirements is unlikely to induce persistent changes in organizations' networking behaviour. |
| Wanzenböck, Scherengell & Fischer (2013) | 155 Austrian firms     |                       | R&D-intensive firms are less likely to substantiate behavioural additonalities; small, young and technologically specialized firms are more likely to realize behavioural additonalities. |

* Multiple samples are used in this study, and 3249 is the average sample size.
** Sample size varies per outcome variable used for behavioural additonality.

financial resources and the managerial support. First, receiving an innovation subsidy increases the level of an SME’s financial resources, and these usable resources need to be devoted to achieving innovation goals. Often, innovation policy programmes demand that SMEs partly complement the innovation subsidy with their own financial resources. Together, these funds need to be invested in innovation projects with uncertain outcomes. Dedicating such additional financial resources to innovation projects can facilitate employee venture behaviour, since money has proven to be vital for the development of intrapreneurial projects and the implementation of ideas which can create new business for the organization (Hornsby, Kuratko, and Zahra 2002; Menzel, Aaltio, and Ulijn 2007). These funds can provide employees with space and time to engage actively in knowledge sharing and learning activities (Chen and Fen Huang 2010), which may lead to new business creation through such intrapreneurial behaviour (Neessen et al. 2019). Therefore, we hypothesize:

H1: Receiving an innovation subsidy has a positive effect on the employee venture behaviour dimension of intrapreneurship in SMEs.
Second, public subsidy programmes often require an innovation to be realized before the full subsidy can be claimed. This provides SME managers with a strong incentive to engage in innovation-related activities. However, especially for SMEs, it is not sufficient for someone in a position of authority to initiate innovation individually or make a strategic decision to innovate alone (Van De Ven 1986). SMEs need to capitalize on the knowledge and initiatives of their employees, both for optimal utilization of their human capital and for market considerations (van de Vrande et al. 2009). Therefore, managers are likely to encourage intrapreneurial behaviour and employees becoming members of strategic project teams (Neessen et al. 2019) in particular when they have to realize an innovation as a result of an innovation subsidy. They realize that valuing and creating perceptions of support for innovation must translate into practices for employees, such as participating in strategic decision making (Antonia, García-Morales, and Javier Llorens-Montes 2008). For these reasons, we hypothesize:

H2: Receiving an innovation subsidy has a positive effect on the employee strategic renewal behaviour dimension of intrapreneurship in SMEs.

**Empirical background and data**

This study investigates the LimburgMakers programme, which commenced in September 2013 and ended in December 2016. Its main objective was to stimulate innovation and enhance the competitiveness and sustainability of manufacturing SMEs in the Dutch province of Limburg. The manufacturing industry provides 16% of all employment opportunities in this province. Because Limburg shares its borders with Belgium and Germany it also features a strong export component (27%), relative to the average in the Netherlands (18%) and demands high knowledge intensity. Furthermore, the manufacturing industry in Limburg functions as an important enabler of other important industries in the province, such as healthcare and agriculture/food.

The LimburgMakers programme featured six subsidy instruments, including knowledge vouchers, knowledge trajectories at a university and subsidies for innovation projects. Eligible SMEs had to have developed and realized innovative physical components, end products or services (e.g. software) that added value to a product. Archival data and informal interviews with officials from the Province of Limburg pointed out that a committee of policy makers and SME owners assessed 403 applications and granted 193 subsidies, for a total amount of €7,200,000. Most subsidies (N = 95) related to innovation projects, for a total of €6,300,000, which meant these SMEs obtained financial support to develop an innovative product or service that could structurally enhance their competitiveness. The maximum amount provided per firm was €70,000, and it could not cover more than 35% of the total project costs. This is in line with other subsidy programmes, because typically innovation subsidies support less than 50% of an innovation project (Czarnitzki and Licht 2006). Next to the innovation project subsidy, the second most common subsidy instrument was a knowledge voucher, and the 45 granted subsidies of this type accounted for €280,000. Because both the number of granted subsidies and the total amount of public money spent on them are the greatest, by far, for the innovation project, we solely focus on analysing the effects of innovation project subsidies in this study.

In early 2014, right after the launch of the LimburgMakers subsidy programme, we identified all 1711 SMEs in the manufacturing industry in the province of Limburg, then sent a questionnaire to their owners or managers, asking about the firms’ organizational routines and innovation-related variables. No subsidies had been granted at that time. In line with the definition by the European Union, an organization is an SME if it employs up to 250 people. The SMEs received an email with a link to the online survey. If we received no response, we sent a reminder email. Thereafter, we sent a reminder letter by postal mail, including a printed survey and reply envelope. A total of 246 SMEs responded, for a response rate of 14.4% – normal for this type of research (Robert Baum, Edwin, and Ken 2001; Mennens et al. 2018; Moreno and Casillas 2008; Wiklund and Shepherd 2005).
February 2016, we sent a second questionnaire out to all the organizations that answered the first survey, along with reminder emails and two telephone contacts if they did not respond. In an ultimate attempt to obtain maximum responses, we made in-person visits to some companies to administer the survey. We thus obtained 92 longitudinal responses (response rate = 37.4%), of which 40 had received an innovation subsidy and 52 had not.

To measure strategic renewal behaviour we use the 7-point Likert perceptual scale resulting from research of Ordelanini and Parasuraman (2011), with the items ‘Employees are actively engaged in establishing goals and priorities for our strategies’ and ‘Employees are adequately represented on project teams and other strategic activities’. To operationalize employee venture behaviour we again used a 7-point Likert perceptual scale and an item from Ordelanini and Parasuraman (2011), namely ‘Employees are actively involved in generating and screening ideas for new services’. Also, from the study of Anderson and West (1998) we used the item ‘Employees in our organization are constantly looking for new ways to solve problems’. To examine whether our measurement items reflect two sub-dimensions of intrapreneurship, we ran confirmatory factor analyses with two latent variables for both rounds of data collection. The factor analyses showed satisfactory values for the thresholds of several model fit indices, namely Chi square, SRMR, TLI, CFI and RMSEA. This indicates that the two subdimensions of intrapreneurship comprising employee venture behaviour and strategic renewal behaviour fit both the data and measurement items well.

The treatment variable (innovation subsidies) is a dummy, equal to 1 if the SME received a LimburgMakers innovation project subsidy and 0 if not. Busso, DiNardo, and McCrery (2014) recommend including control variables if they are expected to influence both the treatment selection process and the variable of interest, to prevent estimation bias. Accordingly, we include firm age (age and age squared, similar to Karhunen and Huovari (2015)), because older firms may be less inclined to innovate (Balasubramaniam and Lee 2008; Chapman and Hewitt-Dundas 2018), such that they might apply less often for innovation subsidies, and their employees might be less inclined to be involved in innovation processes. We also control for firm size, measured as the logarithm of the number of employees (Huergo and Jaumandreu 2004) to avoid biases due to skewness of the data (Aerts and Schmidt 2008). Then, similar to Hottenrott and Lopes-Bento (2014), we control for each SME’s diversity of innovation partners. The SMEs that collaborate with a wider variety of external partners may be more aware of external funding opportunities, such as innovation subsidies. Furthermore, their employees could be more involved in strategic decision making, such as when frontline service employees cooperate with external partners regularly and thus can provide managers with important knowledge insights. We control for growth ambition for the next five years, because SMEs with greater such ambitions likely invest more effort in their innovation process (Schumpeter 1942). In this sense, we expect that growth ambition spurs both the search for innovation subsidy possibilities and intrapreneurship. Previous product and process innovation activity also represent control variables in our analysis, because preceding SME innovation activity influences subsequent innovative behaviour (Cassman and Golovko 2011). Finally, we included frontline employee education, noting that the expertise of employees that are in contact with the market can influence an SME’s ability to attract public funding. Moreover, employees with more education are more intrinsically motivated (Kaiser 2006), which energizes and gives direction to their behaviour (Islam and Zaki Ismail 2008) and thus should enhance intrapreneurship. We asked respondents to indicate the extent to which they agreed that ‘Front-line employees are highly educated’. All survey items and their source are displayed in Table 2.

Methodology

Storey (2008) suggests assessing the effect of an SME policy by monitoring techniques as well as evaluation methods. Monitoring relies on the opinions and views of recipients of the subsidy; evaluation methods attempt to contrast these opinions according to the outcomes achieved from receiving versus not receiving a subsidy. In this study, we follow the latter approach. To measure the
Table 2. Variables and survey items.

| Variable                                      | Survey Item(s)                                                                 | Source                        |
|-----------------------------------------------|--------------------------------------------------------------------------------|-------------------------------|
| Strategic Renewal Behaviour                   | • Employees are adequately engaged in establishing goals and priorities for our strategies  
                                            • Employees are adequately represented on project teams and other strategic activities | (Ordanini and Parasuraman 2011) |
| Employee Venture Behaviour                    | • Employees are actively involved in generating and screening ideas for new services  
                                            • Employees in our organization are constantly looking for new ways to solve problems | (Ordanini and Parasuraman 2011) |
| Age Firm and Age Firm²                       | • In what year was your company founded?                                           | (Karthunen and Huovari 2015)  |
| (Logarithmic transformation of) Firm Size     | • How many employees (in FTEs) does your company currently have?                   | (Karthunen and Huovari 2015)  |
| Diversity of Innovation Partners              | • Indicate whether you collaborate with the following type of partner in the context of innovation: Customers, suppliers, competitors, universities or knowledge institutions and public sector or government | (Laursen and Salter 2006)      |
| Growth Ambition                               | • What is your growth ambition in terms of revenue for the next 5 years ahead compared to today in percentages? | (Delmar and Wiklund 2008)      |
| Frontline Expertise                           | • Frontline personnel is highly trained/skilled                                   | (De Brentani 2001)            |
| Presence of Product Innovation                | • Did your company innovate any products during the past year?                    | (Cassiman and Golovko 2011)   |
| Presence of Process Innovation                | • Did your company innovate any processes during the past year?                   | (Cassiman and Golovko 2011)   |

The effect of receiving an innovation subsidy on intrapreneurship, we consider two potential outcomes for each SME in 2016: \( Y^{2016}_{1} \) and \( Y^{2016}_{0} \). \( Y^{2016}_{1} \) refers to the outcome of an SME that received an innovation subsidy between 2014 and 2016, and \( Y^{2016}_{0} \) refers to the outcome if the SME did not receive a subsidy in the same period. The causal impact of receiving an innovation subsidy for the SMEs in our sample is \( Y^{2016} - Y^{2016}_{0} \). Rosenbaum and Rubin (2006) recommended focusing on the average treatment effect (ATE) with expected outcome \( E(Y) \), which is in our case the average effect of receiving an innovation subsidy on the two dimensions of intrapreneurship, through the expression \( E(Y^{2016} - Y^{2016}_{0}) \). Whereas the ATE estimates the difference in intrapreneurship between subsidized SMEs and unsubsidized SMEs for the entire population, the average treatment effect on the treated (ATT) indicates the difference in intrapreneurship only for the treatment group (i.e. subsidized SMEs) with and without having received an innovation subsidy. As it allows us to isolate the effect of the innovation subsidy on intrapreneurship from other influences (Cantner, Joel, and Schmidt 2011) and focus our analysis on those SMEs that would actually receive an innovation subsidy, we estimate the ATT. We denote the term \( T \) as a dichotomous variable, which is usually referred to as the treatment variable, which takes a value of 1 if an SME received an innovation subsidy and value 0 if it did not receive a subsidy. Leaving out the subscript \( i \), the ATT can be represented as:

\[
\text{ATT} = E(Y^{2016}_{1} - Y^{2016}_{0} | T = 1) = E(Y^{2016}_{1} | T = 1) - E(Y^{2016}_{0} | T = 1)
\]

(1)

The first term \( E(Y^{2016}_{1} | T = 1) \) is the expected outcome for treated firms, whereas the term \( E(Y^{2016}_{0} | T = 1) \) denotes the counterfactual outcome for treated firms assuming they did not receive an innovation subsidy and thus cannot be observed. In principle, this issue can be solved by considering the difference between the treated and untreated SMEs:

\[
\text{ATT} = E(Y^{2016}_{1} - Y^{2016}_{0} | T = 1) = E(Y^{2016}_{1} | T = 1) - E(Y^{2016}_{0} | T = 0)
\]

(2)
However, we encounter two potential issues with the approach consistent with equation 2: First, this equation assumes there is no selection bias, and second, it does not address time-invariant sources of hidden bias. In the remaining part of our methodology, we explain how we address both these issues with our empirical approach. We start with addressing the first issue, which is the assumption that there is no selection bias. This implies that subsidized SMEs are randomly selected from the population so that the subsidized and unsubsidized groups may be considered as comparable in all observable and unobservable characteristics. Nevertheless, R&D subsidies are not randomly distributed (Klette, Møen, and Griliches 2000; Meuleman and De Maeseneire 2012) but rather are assigned through a selection process, which produces exactly this risk of sample selection bias (Herrera and Nieto 2008). A frequently used method to overcome this issue is propensity score matching (Cerulli 2010; Herrera and Nieto 2008). According to this method, we identify the ATT by conditioning the expected values on a univariate quantity called the propensity score (Rosenbaum and Rubin 2006). This propensity score is calculated through a subsidy assignment probability-based probit model and denoted as the conditional probability of receiving the treatment given exogenous information available in 2014 captured by $X^{2014}$:

$$p(X^{2014}) = P(T = 1|X^{2014})$$ (3)

Subsequently matching SMEs with similar propensity scores is equivalent to matching them on the components of $X^{2014}$. The main advantage of using a propensity score, rather than other methods such as selection models, is that no functional form for the outcome equation is required, nor is a distributional assumption about the error terms of the selection and outcome equation (Caliendo and Kopeinig 2008; Czarnitzki and Lopes-Bento 2014). The following equation provides the ATT calculated via propensity score matching (ATT$_{PSM}$):

$$ATT_{PSM} = E_{p(X^{2014})} \{ E(Y^{2016}_1 | p(X^{2014}), T = 1) - E(Y^{2016}_0 | p(X^{2014}), T = 0) \}$$ (4)

This equation accounts for selection bias, because we calculate the ATT$_{PSM}$ by matching subsidized and unsubsidized SMEs employing the propensity score. Because with finite samples it is unlikely to find an unsubsidized SME with an identical propensity score value for each subsidized SME, we rely on matching algorithms to compare subsidized SMEs to unsubsidized counterparts that are as similar as possible in terms of the estimated propensity score. Various matching methods exist, such as nearest neighbour, which is commonly used in innovation domains (Czarnitzki, Ebersberger, and Fier 2007; Herrera and Nieto 2008), as well as kernel matching. These matching estimators differ in how they select and weight non-treated firms and in their capacity to trade bias reduction against efficiency in estimates (Caliendo and Kopeinig 2008). Nearest neighbour matching involves finding one or multiple control group observations with the closest propensity scores for each treated observation. Kernel matching implies that all treated observations match with a weighted average of all controls with weights that are inversely proportional to the distance between the propensity scores of treated and control variables. That is, close matches earn a greater weight, and poor matches take a smaller weight (Becker and Ichino 2002). Kernel matching is our preferred approach, because of its good finite sample properties and lower variance, due to the inclusion of more information (Caliendo and Kopeinig 2008; Frölich 2004). A comparison of results obtained with different methods also indicates the stability and robustness of the effects (Antonioli, Marzucchi, and Montresor 2014). Noting that Busso, DiNardo, and McCrary (2014) recommend estimating average treatment effects with a variety of approaches, we also complement our kernel matching by estimating the ATT with nearest neighbour matching.

The second estimation issue we need to consider is how to control for unobserved time-invariant hidden bias. To that end, we combine propensity score matching with a difference-in-difference estimator. The difference-in-difference estimator is highly effective at protecting estimates from time-invariant sources of hidden bias by taking away the fixed effect components in an equation (Imbens and Wooldridge 2009). Hence, we follow the approach of Pellegrini and Sironi (2017), and
use the difference in the outcome variable over time between 2014 and 2016. For the treated (i.e. subsidized) SMEs, we refer to this as \( Y_{1}^{2016} - Y_{0}^{2014} \) or \( \Delta_1 \), and use the term \( Y_{0}^{2016} - Y_{0}^{2014} \) or \( \Delta_0 \) for the non-treated (i.e. unsubsidized) SMEs. Like equation 4, the ATT is subsequently estimated based on samples that are matched employing the propensity score. The resulting estimator is denoted as the propensity score combined with the difference-in-difference estimator for the average treatment effect on the treated (\( ATT_{PSM-DD} \)) and is used to estimate the differences of the mean of outcomes between 2014 and 2016:

\[
ATT_{PSM-DD} = E_{p(X^{2014})}(\{E[Y_{1}^{2016} - Y_{1}^{2014}] | p[X^{2014}], T = 1\} - \{E[Y_{0}^{2016} - Y_{0}^{2014}] | p[X^{2014}], T = 0\})
\]

\[
E_{p(X^{2014})}(\{E[\Delta_1 | p[X^{2014}], T = 1\} - \{E[\Delta_0 | p[X^{2014}], T = 0\})
\]

(5)

To perform the kernel and nearest neighbour matching algorithms and estimate the \( ATT_{PSM-DD} \) in equation 5, we use the Stata package PSMATCH2 by Leuven and Sianesi (2003). The covariates in the vector \( X^{2014} \), used to calculate the propensity scores, are listed in Table 3. Proper use of this method requires two assumptions to be satisfied: conditional independence and common support. The conditional independence assumption demands that counterfactual outcomes are independent of the treatment indicator, conditional on the covariates. That is, given the set of covariates \( X^{2014} \), the outcomes of the control group are the same as the outcomes of the treated group, had they not been treated (Nolan 2008). According to Rubin (2008), this assumption is the main disadvantage of propensity score matching, in that it implies that all relevant observed variables are included in the estimation of the treatment effect, the variables are measured before the treatment assignment and the covariates of the treatment and control group are fully balanced after the matching procedure. The first requirement cannot be tested, but it requires a propensity score that is based on an adequate set of covariates (Fernández Sastre and Eduardo Vaca Vera 2017). Therefore, sufficient covariates should be used to estimate the propensity score, even if they are statistically insignificant (Millimet and Tchernis 2009). The conditional independence assumption is somewhat weaker when we compare propensity score matching combined with a difference-in-difference estimator against pure matching without differencing (Kahrunen and Huovari 2015), because unobservable differences in characteristics between the treatment and control groups that are constant over time get eliminated when we take the differences of the outcomes (Nolan 2008). Finally, the common support assumption predicts that the propensity scores of the treatment group fall within the range of the propensity scores of the control group.

Because the responses reflect the perceptions of the SME owner or manager, we checked for a potential common method bias, using Harman’s one-factor test (Podsakoff et al. 2003). The test indicated that only 28.35% of the variance is explained by one factor, so no single factor accounts for the majority of the variance. Therefore, our data do not appear to suffer from common method bias.

Results

Before turning to the estimation results, we compare the characteristics of SMEs that receive a subsidy with those that do not. The results of this probit model in Table 3 indicate that firm size, the diversity of innovation partners and growth ambition significantly affect the selection process. That is, smaller SMEs and those that cooperate with more diverse innovation partners are more likely to obtain an innovation subsidy. In addition, those that express greater growth ambitions for the next five years also are more likely to receive a subsidy.

Table 4 contains the descriptive statistics of the covariates before and after the matching procedure. A comparison of the mean values before matching indicates significant differences between subsidized and unsubsidized SMEs on many of the studied variables. Specifically, for firm age, firm age squared, the logarithm of firm size, the diversity of innovation partners and growth ambition, subsidized and unsubsidized groups display different mean values at the 0.05 significance
level, in addition to our dependent variable. The matching procedure attempts to balance these differences in such a way that both groups of SMEs are similar in their covariates (Rosenbaum and Rubin 2006). In Table 4, the p-values of the covariates after the matching procedure are all insignificant. Therefore, we can conclude that the bias between subsidized and unsubsidized firms is reduced, and the matching procedure was successful.

Table 5 contains the ATT results from our analysis, for both SMEs that received a subsidy (treatment, N = 32) and SMEs that did not (control, N = 52). By imposing the restriction of the common support assumption, we removed eight observations from the analysis. Across the different estimators, we find that receiving a subsidy has an insignificant effect on the advancement of employee venture behaviour, thereby failing to provide support for hypothesis 1. Next to this, we report that receiving a subsidy has a consistent, positively significant effect on the development of

Table 3. Probit estimation of the probability of treatment.

| Variable                          | Coefficient (SE) | t-value |
|-----------------------------------|------------------|---------|
| Age Firm                          | 0.02 (0.02)      | 1.18    |
| Age Firm²                         | −0.01 (0.01)     | −1.32   |
| Firm Size (logarithm)             | −0.30 (0.14)     | −2.20** |
| Diversity of Innovation Partners  | 0.44 (0.18)      | 2.39**  |
| Growth Ambition                   | 0.51 (0.22)      | 2.35**  |
| Frontline Expertise               | 0.03 (0.10)      | 0.29    |
| Presence of Product Innovation    | −0.03 (0.43)     | −0.06   |
| Presence of Process Innovation    | −0.42 (0.30)     | −1.40   |
| Constant                          | −3.73 (1.39)     | −2.68***|

*p < 0.1, **p < 0.05, ***p < 0.01.
The dependent variable is receiving a subsidy in 2014. N = 92, Pseudo-R² = 0.19, Prob ≥ \( \chi^2 = 0.0048 \).

Table 4. Descriptive statistics of covariates before and after matching.

| Matching variable                  | Before matching | After matching | p value |
|-----------------------------------|-----------------|----------------|---------|
|                                   | Treatment group | Control group  |         |
| Age Firm                          | 18.38           | 34.00          | 0.010   |
| Age Firm²                         | 619.83          | 2316.60        | 0.024   |
| Diversity of Innovation Partners  | 4.53            | 4.02           | 0.005   |
| Firm Size (logarithm)             | 2.37            | 3.02           | 0.019   |
| Frontline Expertise               | 5.08            | 4.90           | 0.605   |
| Growth Ambition                   | 4.71            | 4.27           | 0.014   |
| Presence of Product Innovation    | 0.85            | 0.85           | 0.960   |
| Presence of Process Innovation    | 0.45            | 0.56           | 0.311   |
| Observations                      | 40              | 52             |         |

|                                   | Treatment group | Control group  | p value |
|-----------------------------------|-----------------|----------------|---------|
|                                   | 21.50           | 21.58          | 0.985   |
|                                   | 759.06          | 710.39         | 0.870   |
|                                   | 4.41            | 4.41           | 0.996   |
|                                   | 2.75            | 2.86           | 0.730   |
|                                   | 4.88            | 5.08           | 0.595   |
|                                   | 4.67            | 4.66           | 0.962   |
|                                   | 0.88            | 0.88           | 0.981   |
|                                   | 0.53            | 0.50           | 0.801   |
|                                   | 32              | 52             |         |

Notes: Eight observations were excluded, due to the common support assumption.

Table 5. Treatment effects on dimensions of Intrapreneurship.

| Outcome variable                  | Kernel | 1 – Nearest Neighbour | 2 – Nearest Neighbour | 3 – Nearest Neighbour |
|-----------------------------------|--------|-----------------------|-----------------------|-----------------------|
|                                   | ATT as | ATT as | ATT as | ATT as |
|                                   | %      | SE     | %      | SE     | %      | SE     | %      | SE     |
| Employee Venture Behaviour (H1)   | 0.10   | 1.87%  | 0.11   | 2.06%  | −0.02  | −0.37% | −0.36  | −1.50%  |
| Strategic Renewal Behaviour (H2)  | 0.74***| 15.32% | 0.26   | 0.72***| 14.90% | 0.34   | 0.68**| 14.07%  | 0.28   | 0.61**| 12.63% | 0.27   |
| N treated                         | 32     | 32     | 32     | 32     | 32     | 32     | 32     | 32     |
| N control                         | 52     | 52     | 52     | 52     | 52     | 52     | 52     | 52     |

*p < 0.1, **p < 0.05, ***p < 0.01.
strategic renewal behaviour, thus confirming hypothesis 2. Namely, the ATT’s from the kernel and nearest neighbour estimations range from 0.61 to 0.74 points measured on a 7-point Likert scale. These estimates are all significant, such that the level of strategic renewal behaviour advanced in subsidized SMEs more than in unsubsidized SMES between 2014 and 2016. Similar to Chapman and Hewitt-Dundas (2018) we also converted these scores to percentages relative to the mean level of strategic renewal behaviour before the start of the subsidy program (in 2014, t = 0) to allow for a more intuitive interpretation of our results. Our various estimation methods indicate that strategic renewal behaviour increased between 12.63% and 15.32% more in SMEs that received an innovation subsidy, compared to unsubsidized SMEs from 2014 to 2016. The limited variation in outcomes across estimation methods for the selection of the control firms and their respective weighting, combined with the consistent outcomes, is an affirmation of the robustness of our findings (Herrera and Nieto 2008).

Conclusion

Substantial public funding has been devoted to subsidies that aim to support SMEs’ innovation projects (Meuleman and De Maeseneire 2012). With this study, we provide empirical evidence for the newly identified, behavioural additionality effect of receiving an innovation subsidy on the employee strategic renewal behaviour dimension of intrapreneurship in an SME (supporting hypothesis 2), but not on employee venture behaviour (rejecting hypothesis 1). Whereas evaluations of public subsidy programmes often focus on input and output additionality, the seminal work by Buisseret, Cameron, and Georgiou (1995) suggests that innovation subsidies also might affect an organization’s internal behaviour. These behavioural additionality effects potentially exert the most enduring impact on organizations (Davenport, Grimes, and Davies 1998). Yet this behavioural additionality had not been tested frequently in prior empirical studies, and evidence of its existence is largely anecdotal (Cerulli, Gabriele, and Poti 2016; Clarysse, Wright, and Mustar 2009). As a result, the mechanisms by which organizations benefit from innovation subsidies have remained obscure (Roper and Hewitt-Dundas 2016). Our study sheds further light on this process.

Our findings in turn offer several contributions. First, we contribute to the SME literature by illuminating how the strategic renewal dimension of intrapreneurship can be stimulated through the receipt of an innovation subsidy. Intrapreneurship evokes positive outcomes related to job satisfaction (Rutherford and Holt 2007), productivity (Maritz 2010), organizational performance (Sieger, Zellweger, and Aquino 2013), and innovation performance (Andries and Czarnitzki 2014; Uhlaner et al. 2013; Fellnhofer 2017; Kelley, Peters, and Colarelli O’Connor 2009). It is even more important for the success of SMEs, which need all their employees and practices to contribute to performance to overcome their resource limitations. That is, SMEs cannot afford to underutilize their workforce and must rely on those staff members for learning, innovation and creativity (Castrogiovanni 2011; Rohlf 2018). Literature specifies financial resources and managerial support as important antecedents of intrapreneurship (García-Morales, Teresa Bolívar-Ramos, and Martín-Rojas 2014; Kelley and Lee 2010; Neessen et al. 2019). Receiving an innovation subsidy can be one such way to stimulate intrapreneurial behaviour related to strategic renewal, as we reveal herein. Nevertheless, whereas the flexible structures of SMEs are more conductive to stimulating intrapreneurship (Carrier 1994), financial resources on its own might be insufficient to reach all the aimed outcomes, as is illustrated for employee venture behaviour in this study. This type of proactive behaviour, in contrast to the more reactive behaviour in strategic renewal activities, necessitates intrapreneurial self-efficacy amongst employees, next to perceptions of organizational support (Chouchane et al. 2021). For some small business entrepreneurs, it might be difficult to tolerate a ‘co-star’ and to provide these entrepreneurial employees with the needed autonomy and support (Carrier 1994). Moreover, the rather small amount of financial resources received by many of the SMEs in this subsidy programme would be insufficient to realize large scale transformations in employees’ proactive entrepreneurial attitudes.
Second, we provide a methodological contribution and respond to calls for longitudinal studies (Autio, Kanninen, and Gustafsson 2008; Catozzella and Vivarelli 2016; Neessen et al. 2019), preferably using repeat measures from the same projects, that examine the temporal dynamics of innovation subsidy effects and intrapreneurship. Most prior studies are cross-sectional; with our longitudinal data set, we combine propensity score matching with a difference-in-difference approach and tease out the longitudinal effect of receiving an innovation subsidy on intrapreneurship.

Third, we address two fundamental issues in additionality research (Gök and Edler 2012), namely, the tendency to treat the organization as a black box and the overlooked SME perspective (Radicic et al. 2015). Subsidies induce private R&D investment or innovation output, but the underlying process by which it might happen has been neglected. This approach even appears in prior behavioural additionality research, such as when researchers measure collaboration behaviour by the change in resources for collaboration or the amount of collaboration (e.g. number of partners) as an output (Gök 2010; Gök and Edler 2012). Such behavioural additionality research disregards an important unit of analysis (Gök and Edler 2012) and excludes the internal dynamics (Gök 2010). By focusing on the development of intrapreneurship as an organizational routine, we address this overlooked unit of analysis (Gök and Edler 2012) and advance understanding of behavioural additionality. In addition, our literature review highlighted that despite the existence of approximately 400 innovation support programmes throughout the European Union (Radicic et al. 2015) only one study investigated behavioural additionality effects in SMEs. Our investigation is one of the first to explore this phenomenon.

Our findings in turn have implications for policy makers and practitioners. Policy makers need empirical evidence that they have spent public money well (Clarysse, Wright, and Mustar 2009). The revealed relationship between receiving an innovation subsidy and the level of SME employee strategic renewal behaviour, an aspect of intrapreneurship, provides new justification for such innovation policies. Our study shows that innovation subsidies have a positive effect on the development of organizational routines, in addition to their documented influence on R&D investments, innovation outputs and external collaboration. Such behavioural additionality effects exert the most durable impact on organizations (Davenport, Grimes, and Davies 1998). For SME owners, we also confirm that subsidies can provide their organizations with financial resources that in turn grant their employees more opportunities to get involved in strategic renewal behaviour.

Our research also has some limitations, amongst else due to data availability. First, while we examine behavioural additionality effects, we only study the effect of one organizational routine, namely intrapreneurship. Further research could address whether other important organizational routines, such as hiring or training routines, also benefit from receiving a subsidy. It would also be interesting to obtain insight into the role the amount of subsidy received plays in stimulating behavioural additionality effects. Secondly, this study relied on self-reported, attitudinal data from one source, and few SME owners are willing to disclose their financial performance data (Naman and Slevin 1993; Poon, Azimah Ainuddin, and Haji Junit 2006). Fortunately, subjective and objective performance data generally are highly correlated in SME contexts (Basco 2014; Dess and Robinson 1984). Still, continued research might investigate whether the increased strategic renewal behaviour levels following an innovation subsidy persist for longer time periods. Fourth, we used measurement items from related, established constructs as proxies to meaningfully operationalize our dependent variables employee venture behaviour and strategic renewal behaviour. Although we strongly believe the measurement items we used in our surveys reflect the subdimensions of intrapreneurship, future studies could validate our findings by employing the intrapreneurship scale developed by Gawke, Gorgievski, and Bakker (2019). Additionally, although we suggest that intrapreneurship in SMEs increases after having received an innovation subsidy because it might lead to more managerial support and financial resources, we did not test these intermediate processes. Including these mechanisms would be a recommendation for future investigations; Finally, our sample consists of actual SME owners in the Dutch province of Limburg, reflecting the scope of the LimburgMakers subsidy program. Thus, our sample size is limited. Considering the specific geographic region in which we conducted our research, the generalizability...
of our results is uncertain. Further investigations might extend our findings by evaluating the effect of innovation subsidies on intrapreneurship within a larger subsidy programme or in a different region.

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Availability of data and material

The data that support the findings of this study are gathered in collaboration with and owned by the Province of Limburg and are not publicly available. However, the data may be available from the authors upon reasonable request and with permission of the Province of Limburg.

Authors’ contributions

All authors made a substantial contribution to this paper by drafting it or revising it critically. In addition, all authors approve this version to be taken into consideration for publication and agree to be accountable for all aspects of the work.

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