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AI-Powered Innovation Management Increases Employee Innovativeness

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Abstract: This study investigates the effect of an intervention aimed at improving employee innovativeness. Although employees show just as much innovative potential as entrepreneurs, entrepreneurs outperform employees in innovative outcomes. As a result, many dormant innovators remain undiscovered and unsupported. This study explores the effect of increasing support with Lakmoos, an AI-based tool stimulating employee innovativeness. In the pretest-posttest quasi-experiment with 28 participants, we launched a four-day program in the intervention group while offering no support in the control group. After completing the program, the intervention group had a bigger increase in innovative behaviour, innovation support and intrapreneurial behaviour compared to the control group. Similarly, the Bayesian repeated-measures ANOVAs show strong evidence supporting the effect of the intervention on innovation support and intrapreneurial behaviour. These results bring a promising outlook on using AI-based tools to support innovation within companies at scale.

Keywords: innovation; innovation management; network model; network analysis; innovativeness; intrapreneurship; psychology; AI; perceived innovation support, innovative behaviour.

1 Introduction

Innovation is the fundamental force that moves our world forward, and an innovative workforce drives the change. Employee innovativeness consists of a set of behaviours that create, introduce, and apply new ideas to contribute to the performance of their organization (Janssen, 2000). Most employees also display sufficient levels of creativity and problem-solving to find innovative solutions (Tidd & Bessant, 2009). What is more, employees who feel empowered to innovate are more engaged and productive (Ali et al., 2022). In contrast with the common misconception, research provides evidence that employees can create meaningful innovation, and companies benefit from empowering

their employees at mass. Employee innovation is closely tied to intrapreneurship, i.e. activities contributing to corporate venturing and strategic renewal (Gawke et al., 2019). Intrapreneurship has been shown to develop and maintain competitive advantage (Morris et al., 2011), relate to higher profits (Bierwerth et al., 2015), create public value and increase effectiveness (Kearney & Meynhardt, 2016). Innovative and intrapreneurial behaviour seems crucial for companies to hold a competitive advantage in today's rapidly changing world.

At the same time, companies struggle to bring out the innovative potential of the talent they hire. Literature reveals internal and external factors influencing the amount of displayed innovative behaviour, such as perceived organizational support (Yldiz et al., 2017). Moreover, employees have as many innovative ideas as entrepreneurs but do not produce as many outcomes as entrepreneurs (Lukes & Stephan, 2017). Employees keep dreaming and never start doing. Research suggests that it is not laziness but a lack of financial and social resources that prevents non-managerial employees from innovating (O. C. Tanner Institute, 2019). Employees find innovation management discouraging and are prone to fall into learned helplessness (Maier & Seligman, 1976). In other words, when an employee submits an idea, and nothing happens, she will not do it again. As a result, only a small fraction of innovative employees visibly share their ideas, while most innovative potential remains dormant.

That raises the question how we can support employees in their innovative endeavours.

The advent of artificial intelligence (AI) and machine learning (ML) has already been noted in organisational management. Early research explores the potential of using AI in innovation management and pinpoints the anticipated transformation of innovation management (Füller et al., 2022). This study is the first to look past the benefits of using AI to analyse data patterns and focus our curiosity on exploring how an AI-based solution could impact purely human activity, that is, innovative behaviour.

This study pilots an intervention program designed by Lakmoos to increase innovative behaviour across organisations. Being an AI-based online tool that automates corporate innovation and predicts the success of innovative ideas, Lakmoos enables testing pre-prototype ideas at scale by providing instant feedback on innovative ideas. The tool empowers all employees to innovate and increases perceived support of innovation.

This study aims to explore the impact of an intervention using an AI-based tool on innovative behaviour. Namely, we hypothesise that by using Lakmoos to provide innovators with instant feedback on their ideas, we increase innovative and intrapreneurial behaviour.

Hypothesis 1 The use of an AI-based tool to manage employee innovation relates to an increase in perceived innovation support, innovative behaviour and intrapreneurial behaviour compared to a control group without an AI-based tool.

2 Method

Design

This intervention study follows the change in innovativeness in a quasi-experimental design with one control and one intervention group analysed with repeated-measures ANOVA. Both groups report their innovative behaviour (measured by IBI), perceived innovation support (measured by ISI) and intrapreneurship behaviour (measured by EIS) in an online pretest and posttest survey.

We expect the intervention to have an effect on observed innovative behaviour, perceived innovation support and/or intrapreneurial behaviour, and thus we hypothesize that the *change* in IBI, ISI, and/or EIS during the study will be greater for the intervention group than control.

For the Bayesian analyses, we expect to observe strong evidence for models containing the main effects of both time and group and their interaction for all three dependent variables.

Participants

Three European SMEs offered 20 – 30 participants (each) for the study. Since all employees from one company work in same building on the same floor, they can't be expected not to talk about the intervention with each other. Establishing control and intervention groups within each company could result in confusion. Two SMEs were assigned to the intervention group ($n_1 = 30$, $n_2 = 12$) as a higher attrition rate was expected. Only one SME participated as a control group (n = 28). All levels of seniority were represented in both groups, and the age of participants was comparable between the intervention ($M = 31.5$, $SD = 1.4$, min = 22, max = 45) and control group ($M = 30.0$, $SD = 1.4$, min = 19, max = 41). All roles and seniority levels were represented in each group. All participants included in the analysis provided an informed consent.

Measures

This study uses the framework of Lukes and Stephan (2017), which considers individual and organisational factors to build a system of innovativeness. Many attempts have been made to map how innovation happens: measuring creativity (Tierney et al., 1999) or champion behaviour (Howell et al., 2005). However, Lukes and Stephan (2017) created the first integrative measure of innovativeness that considers individual and contextual factors. Their research shows that innovativeness is a system where the perceived support of managers, organization and culture play key roles.

Pre-test and post-test assessments included the same three validated scales: Innovative Behaviour Inventory (IBI), Innovative Support Inventory (ISI; both scales developed by Lukes and Stephan, 2017) and Employee Intrapreneurship Scale (Gawke et al., 2019). Additionally, we measured demographic data, such as gender, age, or role.

The 4-day program intervention program is expected to impact some aspects of innovative behaviour, innovative support, and employee intrapreneurship, but some aspects measured by the scales we used are beyond the scope of such a short intervention. For example, it is beyond the scope of the program to influence items asking about the experience "Whenever I worked somewhere, I improved something there". We also excluded items that could not occur during a four-day intervention, such as "My manager always financially rewards good ideas.", as this intervention did not alter the system of financial rewards. Thus, to measure the impact of our intervention, we selected a subset of items of the IBI (6 out of 23) and the ISI (3 out of 12) which measure aspects that our intervention might affect within such a short time (see Table 1). For the EIS, we only excluded 2 out of the 15 items (see Table 2).

Table 1 IBI and ISI items ***in***cluded in the adjusted scales.

Item	*Scale*
I try new ways of doing things at work.	IBI
When something does not function well at work, I try to find new solution.	IBI
When I have a new idea, I try to get support for it from management.	IBI
I try to get new ideas from colleagues or business partners.	IBI
I am interested in how things are done elsewhere in order to use acquired ideas in my own work.	IBI
I search for new ideas of other people in order to try to implement the best ones.	IBI
My manager motivates me to come to him/her with new ideas.	ISI
My manager supports me in implementing good ideas as soon as possible.	ISI
Our organization provides employees time for putting ideas and innovations into practice.	ISI

Table 2 EIS items ***ex***cluded from the adjusted scale.

Item	*Scale*
(Excluded) I undertake activities to set up new business units.	EIS
(Excluded) I undertake activities that result in new departments outside of my organization.	EIS

Procedure

The study took place between the 11th and 14th of April, 2023. The control group only received an online survey on the first and last day of the study. The intervention group received a standardized official email from the CEO about participating in the program. Their CEO introduced Lakmoos and invited employees to fill in the first survey. After employees completed the pre-test, each received a message in their inbox prompting them to visit their personal Lakmoos centre and submit an innovative idea (see Figure 1). They saw three examples of ideas (e.g. launch a blog about healthy workspace) and were asked

to submit theirs in 20 – 100 words. Each idea received instant feedback in three parts: a short evaluation summarizing potential benefits in words, a total score of the idea in percentage, and a breakdown of that score in five indicators measuring desirability, market, risk, budget, and also compared the idea with similar ideas in a central database of innovative ideas. The best ideas (total score above 80 %) were flagged and could be saved to a super-list. These prompts were repeated on the second and the third day. A post-test was completed on the final day of the study.

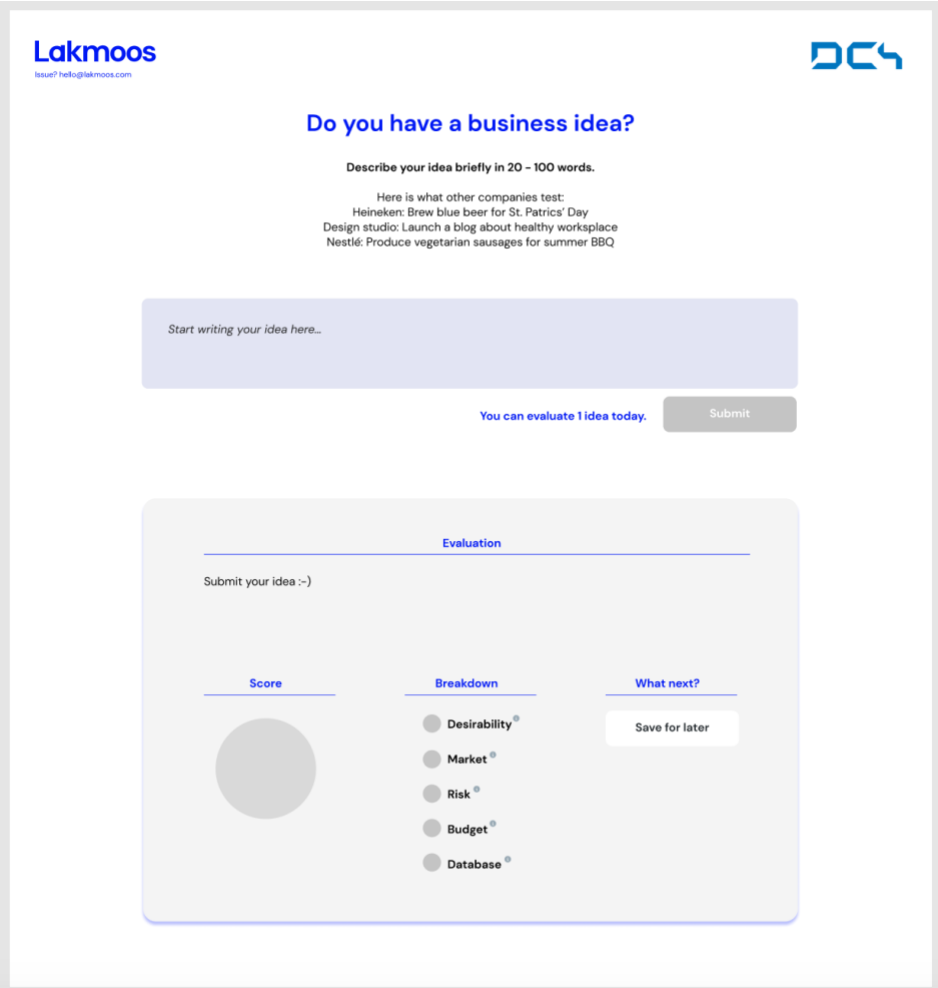

Figure 1 Lakmoos idea deposition for the intervention group.

3 Results

The pre-test was completed by 28 respondents from the experimental group and 22 respondents from the control group. However, 4 respondents from the intervention group

and 6 respondents from the control group did not consent to their data being used in this study. Thus, the study was run with 24 participants in the intervention and 16 participants in the control group. Each participant from the intervention group received three prompts during the intervention. All prompt emails were opened. Employees in the intervention group clicked on the prompts 72 times and submitted 21 ideas. The post-test was completed by 12 participants in the intervention group (50 % attrition, 7 female, m_{age} = 31.25, sd_{age} = 2.49) and 16 participants in the control group (0 % attrition, 10 female, m_{age} 31.63= , sd_{age} = 1.455).

Three separate repeated measure ANOVAs were performed for each scale with time (pre-test, post-test) as a within-subjects factor and group (intervention, control) as a between-subjects factor. Assumptions for were checked, including Levene's test for equality of variance and outliers. All analyses were carried out in SPSS and JASP (JASP Team, 2023).

IBI Innovative Behaviour Inventory

Table 3 shows the scores on the IBI on the pre- and post-test. A repeated-measures ANOVA was performed to compare the effect of the intervention on innovative behaviour. The analysis did not reveal any statistically significant main effect of time [$F(1,26) =0.041$, $p = .842$, $eta_p^2 = .002$] nor group [$F(1, 26) = 1.993$, $p = .176$, $eta_p^2 = .069$]. However, there was a significant interaction effect between time and group [$F(1, 26) = 6.536$, $p = .017$, $eta_p^2 = .201$]. Figure 2 shows that on the pre-test, the control group scored higher than the intervention group on innovative behaviour, but on the post-test, this was reversed. A post-hoc test showed no significant difference in innovative behaviour for the control group in the pre-test and post-test ($t = 2.107$, $p_{Bonf} = 1.00$, Cohen's $d = .777$). This was also the case for the intervention ($t = -1.558$, $p_{Bonf} = .788$, Cohen's $d = - .663$). Although it is not possible to rule out alternative explanations of the differences between groups, it would be reasonable to hypothesize this effect in the following study with a bigger sample.

Table 3 Descriptives for pretest and posttest scores of IBI (min = 1, max = 5) in control and intervention group.

	Pretest Con	*Pretest Int*	*Posttest Con*	*Posttest Int*
M	3.18	2.85	2.46	3.45
SD	0.73	1.19	0.80	0.97

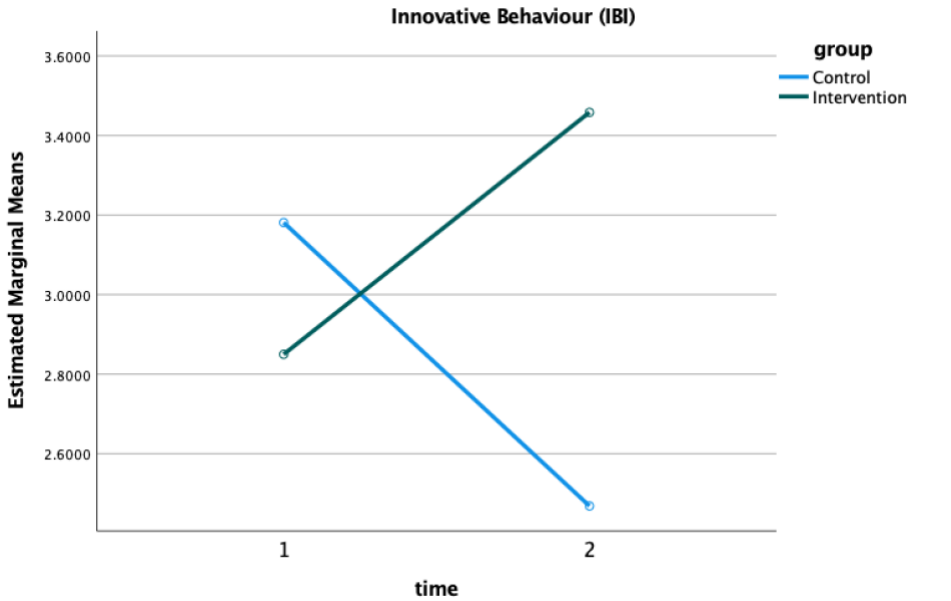

Figure 2 Change in innovative behaviour before (time 1) and after (time 2) intervention for the control group (blue) and intervention group (green).

The Bayesian repeated-measures ANOVA provided little support for our hypothesis as well. Neither the main effect of time (BF_{10} = 0.311) nor group (BF_{10} = 0.509) indicated substantive evidence for our expected effect of the intervention. A full model including time, group, and their interaction did not fit the data either (BF_{10} = 1.461). However, Figure 3 illustrates a small effect of the intervention on innovative behaviour (R^2 = .234), with a 95% credible interval ranging from 0.113 to 0.383. Although we observe a change in innovative behaviour for the intervention group in our sample, we do not have enough evidence to generalize this effect to the whole population.

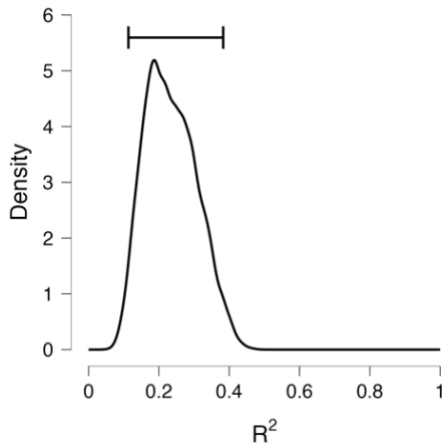

Figure 3 Model averaged posterior R^2 for innovative behaviour.

ISI Innovative Support Inventory

A repeated-measures ANOVA was performed to compare the effect of the intervention on perceived support for innovation. The analysis did not reveal any statistically significant main effect of time in innovative support [$F(1,26) = 1.224$, $p = .279$, $eta_p^2 = 0.047$] nor group [$F(1, 26) = 1.910$, $p = .179$, $eta_p^2 = 0.071$], however, interaction of group and time was significant [$F(1, 26) = 18.862$, $p < .001$, $eta_p^2 = 0.430$). Post hoc tests with Bonferroni correction showed a large significant difference between the pre-test and post-test for the intervention group ($t = -3.450$, $p_{Bonf} = .010$, Cohen's $d = -1.441$) while not detecting any significant change in the control group ($t = 2.536$, $p_{Bonf} = .107$, Cohen's $d = 0.856$). These results suggest that the intervention and control groups differ in how their perception of innovation support changed during the intervention: perceived organizational support increased for the intervention group and decreased for the control group.

Table 4 Descriptives for pretest and posttest scores of ISI (min = 1, max = 5) in the control and intervention groups.

	Pretest Con	*Pretest Int*	*Posttest Con*	*Posttest Int*
M	2.94	2.13	2.02	3.69
SD	1.16	1.09	1.01	1.04

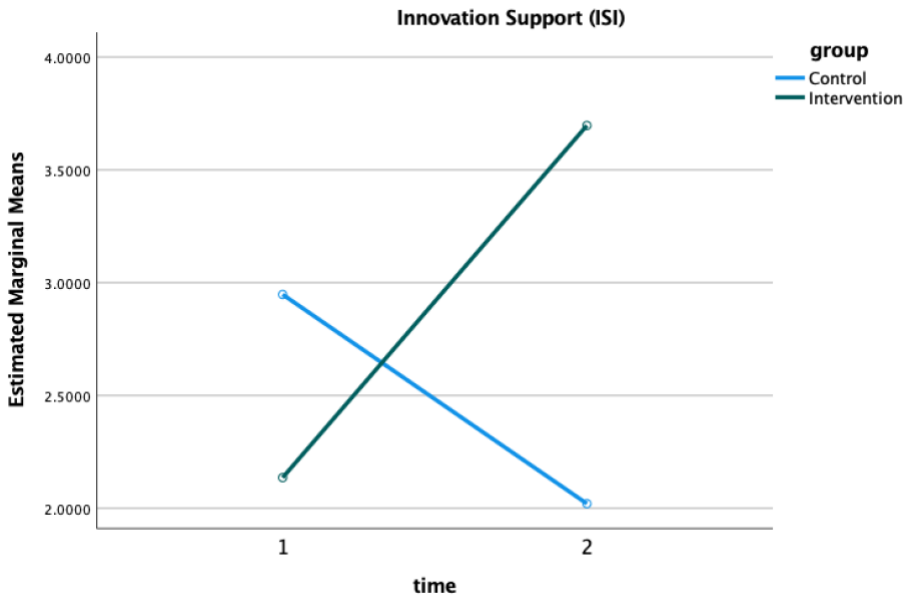

Figure 4 Change in perceived innovation support before (time 1) and after (time 2) intervention for the control group (blue) and intervention group (green).

Using a Bayesian repeated-measures ANOVA, the data provided strong support for a model that includes the main effects of time and group and their interaction (BF_{10} =

111.452). In other words, the observed data were 111x more likely to occur under the model, including both main effects and their interaction, compared to the null model with average as a sole predictor. This indicates strong evidence for the effect size of the intervention. Figure 5 represents this finding, showing a medium effect of the intervention on innovation support [R^2 = .416, 95% CI (0.286, 0.532)]. The model featuring only main effects revealed little support, namely the main effect of time (BF_{10} = 0.521) or main effect of group (BF_{10} = 0.279).

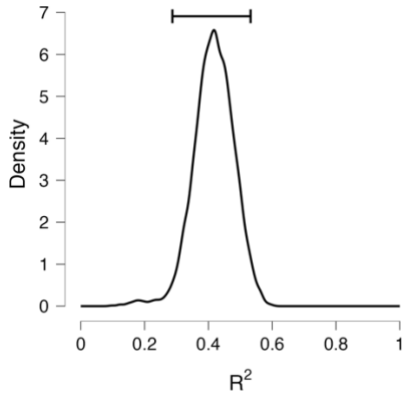

Figure 5 Model averaged posterior R^2 for innovation support.

EIS Employee Intrapreneurship Scale

A repeated-measures ANOVA was performed to compare the effect of the intervention on intrapreneurship. The analysis did not reveal any statistically significant main effect of time in innovative support [F(1,26) = 3.645, p = .067, eta_p^2 = 0.123]. However, a significant main effect for the group was found [F(1, 26) = 4.808, p = .037, eta_p^2 = 0.156]. Furthermore, a significant effect of the interaction between the group and time was found [F(1, 26) = 9.990, p = .004, eta_p^2 = 0.137]. Subsequent post hoc tests with Bonferroni correction showed a large significant difference between the pre-test and post-test for the intervention group (t = -3.353, p_{Bonf} = .015, Cohen's d = -1.344) but no significant difference for the control group (t = .956, p_{Bonf} = 1.00, Cohen's d = .332). These results suggest that the intervention and control groups differ in intrapreneurship measures: while the intervention group increased their intrapreneurial behaviour, the control group noted a decrease in intrapreneurial behaviour.

Table 5 Descriptives for pretest and posttest scores of EIS (min = 1, max = 5) in control and intervention group.

	Pretest Con	*Pretest Int*	*Posttest Con*	*Posttest Int*
M	2.55	2.32	2.22	3.67
SD	1.00	1.01	0.91	1.10

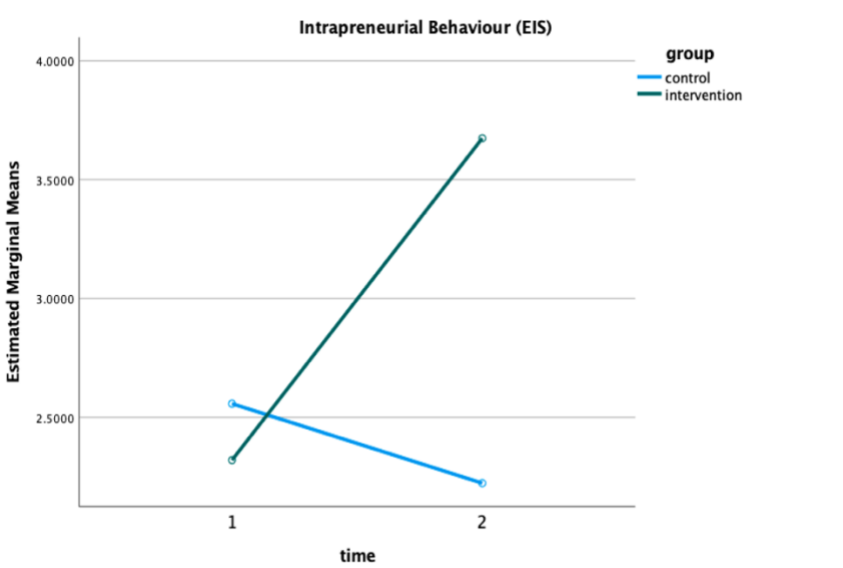

Figure 6 Change in intrapreneurial behaviour before (time 1) and after (time 2) intervention for the control group (blue) and intervention group (green).

In a Bayesian repeated-measures ANOVA, the best-fitting model includes the main effect of time, the main effect of group, and their interaction between time and group as predictors to account for the observed data (BF_{10} = 21.069), indicating strong evidence for the effect of the intervention. In other words, the increase of intrapreneurial behaviour is 21 times more likely to occur within the intervention group given the data compared to the null model with average as a sole predictor. The analysis revealed a medium effect size of the intervention on intrapreneurial behaviour (R^2 = 0.355), with a 95% credible interval ranging from 0.171 to 0.493, as depicted in Figure 7. The model featuring only the main effects did not reveal much support, with the main effect of time (BF_{10} = 0.625) and main effect of group (BF_{10} = 1.067). These findings suggest that the observed change in intrapreneurial behaviour was unique to the intervention group and developed over time.

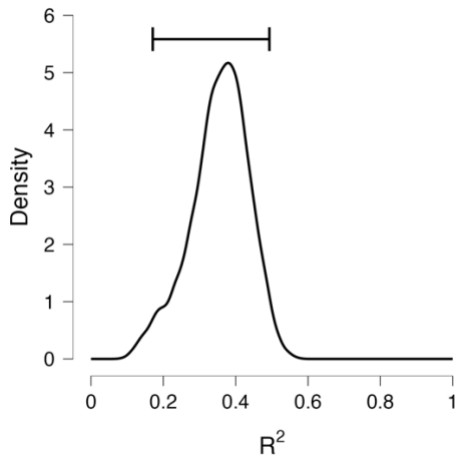

Figure 7 Model averaged posterior R^2 for intrapreneurial behaviour.

4 Discussion

This pilot study aimed to explore possible opportunities in using an AI-based tool in innovation management. A four-day intervention program was conducted in the intervention group, while the control group received no support. As expected, only large effects could be detected in a small sample size of 28 participants. Although results show promising directions for IBI and ISI for future research with a larger sample, the only large effects were detected for EIS. Participants who received the intervention reported higher scores of EIS compared to their scores before the program and compared to the control group. The study shows significant improvement in perceived innovation support and intrapreneurial behaviour over time in the intervention group but not in the control group. Although the increase in innovative behaviour in the intervention group fell short of significance, the medium effect sizes suggest this might be due to insufficient sample size in this study. All in all, the results of this pilot study show strong effects of the intervention of employee innovativeness and reveal a promising area of research.

The surprising element is the minuscule amount of work done in the intervention group, which still influenced their innovativeness. The debriefing interviews with the companies show that our intervention sparked discussion, and more people collaborated to submit one idea. The social aspect of innovating together could have also contributed to the found effect. This seems especially promising given the short duration of the intervention and the simplicity of the beta testing system, which has not yet been fully implemented.

Limitations

This pilot study has several limitations, including a small sample size. Only large effect sizes are likely to be significant in small samples, as we also witness in this case. All significant effects are unusually large, Cohen's $d > 1$, whereas other medium to large effects were not found as significant. The effect size can also be inflated due to the high attrition rate in the intervention group causing selective dropout: employees who did not see value the of Lakmoos might not have completed the post-test and thus were not considered in the analysis. More insight is needed to determine the reasons for not completing the post-test. Nonetheless, the results give us strong reasons to believe that a similar effect will be found in a similar study with an extended sample size in the future.

Furthermore, not all behaviours could manifest during the short period of the pilot study. Especially items of ISI seem to require more long-term intervention to detect a change in the organisation's approach to supporting innovation. The selection of included and excluded items of IBI, ISI, and EIS will need to be done more carefully for the following study to reduce variability in the data. It could be expected to see more effects for longer interventions.

The next study should consider a sample from one large organization only. This pilot study gathered 50 participants from three companies which could have brought extra noise to the results, thus obscuring the effects of the intervention. The following study should find employees for both groups within one organization.

5 Conclusion

This pilot study brought results supporting the effect of an AI-based intervention program on the innovativeness of employees. Follow-up studies should consider larger samples and random assignment of individuals to get a better estimate of the effects found in this study. The full experimental design could verify whether found effects are robust and to what extent they can be generalized. Overall, this study brings a promising outlook on using AI-based tools to support employee innovativeness within companies at scale.

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