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# Study of effectiveness of NUMO application in lowering ADHD symptoms in adults

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✎ **ABSTRACT.** Lo studio analizza l'efficacia dell'applicazione NUMO nel ridurre i sintomi dell'ADHD negli adulti. La ricerca ha coinvolto 87 partecipanti, divisi in due gruppi in base all'intensità d'uso dell'app. Dopo tre mesi, il gruppo ad alta intensità ha mostrato miglioramenti significativi nei sintomi di disattenzione e iperattività, oltre a un aumento della qualità della vita. Anche il gruppo a bassa intensità ha dimostrato alcuni miglioramenti, che però sono stati significativamente minori. I risultati suggeriscono che l'app NUMO, usata intensamente, può essere uno strumento utile per la gestione dell'ADHD, sia come supporto di interventi psicoterapeutici, che come uno strumento a sé stante.

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✎ **SUMMARY.** *Low executive functioning in people with ADHD leads to poor adaptation (Barkley, 1997). These deficits not only affect academic and occupational performance but also interfere with therapeutic interventions, for example, creating difficulties in doing homework in psychotherapy that itself aims to improve executive functions (Safren et al., 2005). An app that offers evidence-based exercises could potentially ease cognitive behavioural therapy (CBT) homework and/or be an autonomous top-bottom tool (Baumel et al., 2019). One such app is NUMO, which integrates psychoeducation, task management, and cognitive exercises designed to address ADHD symptoms This study checked the effectiveness of NUMO app in lowering ADHD symptoms and increasing the quality of life. 87 participants between 25 and 45 years of age were initially included in this study. All of them were previously diagnosed with ADHD and had never used NUMO before. The exclusion criteria were addictions and schizophrenia/psychosis. It was decided to run a quasi-experiment, that permitted to follow the natural behavioural patterns of the participants. 53 of them were therefore analyzed as the high-intensity group and 10 as the low-intensity group. Some others were excluded as they did not follow any constant pattern of interaction with the app or dropped-out. There is a need to mention that the participants were motivated to continue the interaction with NUMO by a gift certificate they received after this 3 month. There were used paired samples t-tests to compare pre- and post-experimental results in Conners (Conners Adult ADHD Rating Scales – CAARS) screening form and questions regarding the quality of life. The significant difference in every Conners screening form scale and the questions on quality of life was found in the results of the high-intensity group before and after using NUMO for 3 months. Meanwhile, the low-intensity group that used NUMO occasionally and with low-intensity showed some dynamics, but it was less significant. NUMO application is effective in lowering ADHD symptoms and improving the quality of life in adult people with ADHD. However, the findings suggest that continuous engagement with the app is necessary to achieve optimal results, consistent with the notion that sustained and intence interventions are needed to drive neuroplastic changes and lasting behavioral improvements (Kazdin, 2017).*

**Keywords:** ADHD, App NUMO, Quality of life, Behavioral improvements

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## INTRODUCTION

ADHD is a neurodevelopmental condition characterized by persistent inattention, hyperactivity, and impulsivity, which significantly impair daily functioning. Executive functioning such as planning and self-regulation, is particularly affected in individuals with ADHD. These deficits can result in poor adaptation, making it difficult for individuals to organize tasks, manage time, or regulate their emotions effectively. ADHD persists in 70% of adults who have been diagnosed during childhood (Wilens, Biederman & Spencer, 2002). Moreover, the remaining 30% normally show some symptoms but do not fulfil the diagnostic criteria. The prevalence of ADHD is between 2 and 5% of the adult population (Barkley, 2006). The impulsivity and hyperactivity symptoms tend to diminish while inattention tends to remain constant during the lifespan. The difficulties in concentration and self-organization represent a serious problem for an individual's work and personal life. Adults with ADHD have lower income in average, which is partly related to a lower education level (they fail to complete studies) (Biederman & Faraone, 2005) and to a tendency to fail to complete tasks, disorganization in the working process, poor attention that led to poor work performance (Kessler et al., 2005).

A multimodal approach that includes not only medication, but psychotherapy and behavioural coaching/mentoring is preferable in the treatment of ADHD. The top-bottom approach is extremely helpful to individuals with ADHD, helping them to learn strategies that lead to more productive behaviour and better adaptation. However, the impairment in executive functions can also extend into the realm of therapeutic interventions. For example, cognitive behavioural therapy (CBT) usually includes homework assignments designed to build self-organization skills. However, individuals with ADHD may struggle to complete CBT homework due to their inherent difficulties with executive functioning, leading to lack of generalization and poorer therapy outcomes (Barkley, 2014; Antshel, Faraone & Hartsough, 2011).

Recently, the integration mobile health applications into psychotherapy has shown promise in addressing some of these problems. These tools can offer evidence-based exercises and strategies that promote skill-building in executive functioning while alleviating some of the practical challenges associated with traditional therapy formats (Torous, Rosenbaum & Wykes, 2018). One such tool, the NUMO application,

is designed to help building new skills and support CBT protocols by providing interactive exercises. NUMO aims at improving organization and emotional regulation, lowering distractibility. The app is designed not only as a homework aid but also as an autonomous intervention tool, for example for individuals who may not have access to psychotherapy.

The study aims to evaluate the effectiveness of the NUMO application in reducing ADHD symptoms and improving the quality of life in adults. Mobile applications designed for ADHD management have increasingly become the subject of research as they offer a more accessible option for individuals seeking self-help or adjunctive therapy (Baumel, Edan & Kane, 2019; Kazdin, 2017). The study does not only verify the efficiency of NUMO app but, by examining both high-intensity and low-intensity users, provides empirical data on how the app's usage correlates with improvements in ADHD-related outcomes. It was decided to run a quasi-experiment as it studies the real behavioural patterns of NUMO's users.

## METHODS

The study was carried out on adults (25-45 years old), who had been diagnosed with ADHD. Only new NUMO users were recruited for the study. The exclusion criteria were alcohol or drug addiction, psychosis, bipolar disorder, schizophrenia; the early beginning of pharmacological or psychotherapeutic treatment of ADHD. We analysed 87 cases, 53 of them fell to high-intensity group and 10 to the low-intensity group. Other participants did not fit any pattern or dropped-out.

The aim of this study was to check the effectiveness of NUMO app in the development of organizational skills and in lowering ADHD symptoms in people with ADHD. The experimental hypothesis was that using NUMO frequently and intensively (at least completing 3 tasks at a time and skipping less than 10 days out of 90) would significantly improve the quality of life and lower ADHD symptoms. The experiment lasted three months.

The participants were measured with *Conners Adult ADHD Rating Scales (CAARS)* screening form in the beginning and in the end of the study. Also, their level of adaptation and the impact of ADHD on their life was measured by the following questions: "Generally, I feel productive in my daily life", "I struggle with my ADHD symptoms".

The study represents a quasi-experiment. Two groups of

participants were selected for further analysis. The first group (high-intensity) used NUMO app almost every day (skipped less than 10 days out of 90), performing at least 3 tasks a time on average. So-called low-intensity group skipped more than 30 days, performing less than one task on average, but still did use the app during the 90 days and had a constant pattern of low-intensity users.

NUMO is an app that combines psychoeducation, science-based exercises, and a supportive community made of people with ADHD. This study was focused on performing tasks. The tasks put together the best CBT practice. Specifically, the participants of the experimental group constantly used a daily planner that gave them a possibility to transfer tasks to the calendar. The other frequently used task was a task division into small parts which helped to win out the procrastination. Many participants used thoughts testing technique, that helped them lower anxiety or sadness along with the diminishment of procrastination or harmonizing social interaction. Participants also used additional tools, like white noise, for example. Users got involved in group activities where they could share their goals and track their accomplishments with other participants. It gives users additional motivation, structure, and emotional support.

## RESULTS

After three months, the results of the two groups before and after were compared.

The differences in pre- and post-experimental results were compared using paired samples *t*-test (see Table 1).

Significant differences between scores on CAARS screening form results were demonstrated in the pre- and post-experimental results of the high-intensity group (see Figure 1). There are significant differences (<.001) in every one of the four scales. Moreover, there are significant differences in answers to questions on quality of life. There is <.001 significance level difference between pre- and post-experimental answers to the question “Generally I feel productive in my daily life” and a .041 significance level difference between answers to the question “I struggle with my ADHD symptoms”. A less significant difference in the second question is expected because the participants did not get rid of ADHD and did not stop suffering from its outcomes. However, they showed a lower level of discomfort.

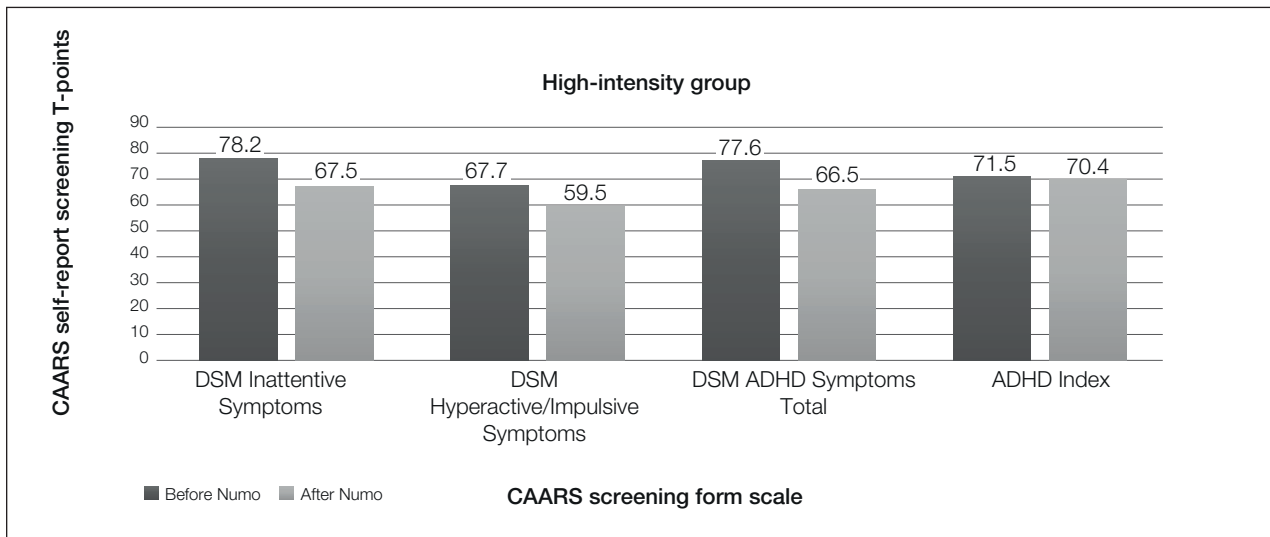
Before using the application, 5% of experimental group participants reported not being productive at all, 69% being

**Table 1** – The differences in high-intensity group pre- and post-experimental results

Source	<i>t</i>	<i>df</i>	<i>p</i>	<i>Cohen's D</i>
Inattentive symptoms	8.52	52	<.001	.91
Hyperactive/impulsive symptoms	6.39	52	<.001	.85
ADHD symptoms total	8.47	52	<.001	1
ADHD index	10.76	52	<.001	1.4
Generally, I feel productive in my daily life	-4.67	52	<.001	-.65
I struggle with my ADHD symptoms	3.15	52	.003	.45

*Legenda.* *df* = degree of freedom.

**Figure 1** – The difference between CAARS screening form results for high-intensity group before and after the experiment



just a little productive and 26% claimed being pretty much productive. While 2.6% reported not being struggling at all with their ADHD symptoms, 64.1% struggling pretty much and 33.3% were struggling very much (see Figure 2).

After 3 months of constant usage, 2.6% claimed being not at all productive, 38.5 being just a little productive, 51.3% being pretty much productive and 7.7% being very much productive. While 25.6% reported struggling very much with ADHD symptoms 43.6% of pretty much struggling and 30.8% struggling just a little (see Figure 3).

The paired samples *t*-test showed low difference in before and after experiment in CAARS screening form results and answers to two questions on quality of life (see Table 2). However, this group might have had some benefits from its occasional usage of Numo, as their results of CAARS (but not additional questions) got a little better (see Figure 4).

The answers distribution on productivity remained the same. It is plausible as participants built no new skills. Exactly the same numbers could be explained by a small number of this sample. The level of struggling with the ADHD symptoms went even worse than before. Maybe, it could be explained by frustration by inability to follow the program (or other life circumstances) (see Figure 5 and Figure 6).

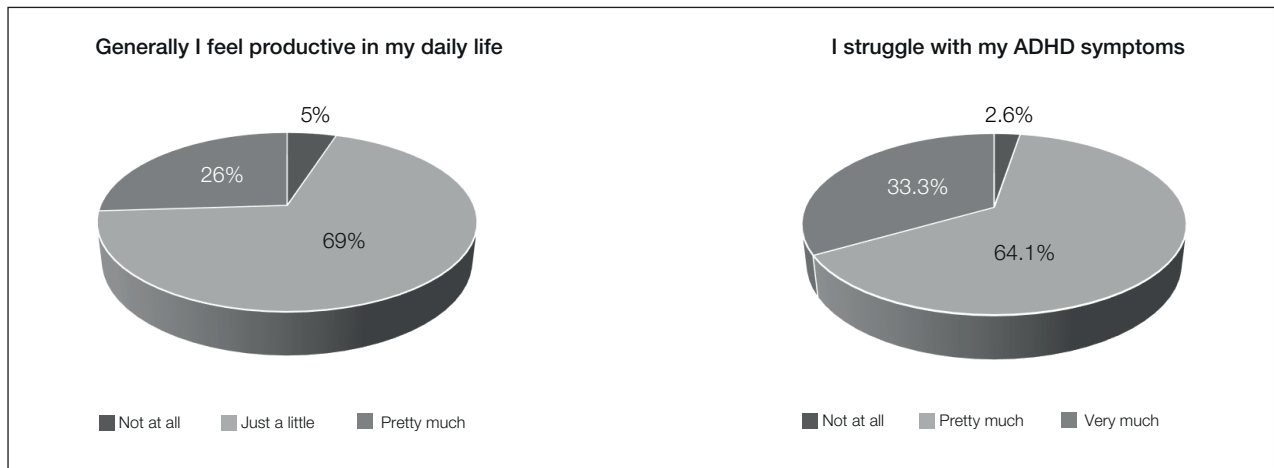
We need to mention, that there was no significant difference between pre-experimental CAARS screening form results of high- and low-intensity group (see Table 3).

## DISCUSSION AND CONCLUSION

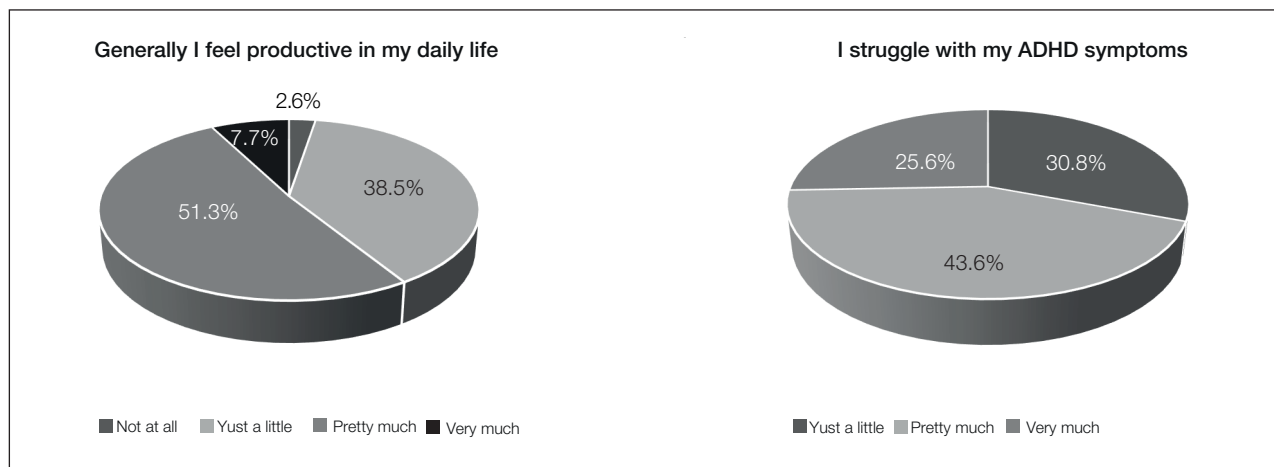
From the experimental data, it can be concluded that NUMO application is effective in symptom reduction and improvement of quality of life. However, intense, and frequent usage is required. It is known, that only massive stimulation can lead to LTP and therefore, to neuroplastic changes and the installation of new skills.

The results were predictable, as NUMO is based on cognitive behavioural therapy exercises like task division, planning, group-based motivation that are evidence-based itself challenges (Baumel, Muench & Kane, 2019). It is consistent with previous researches showing the effectiveness of CBT in improving executive functioning in individuals with ADHD (Safren, Sprich, Chulvick & Otto, 2005). However, one tool that puts together the basic ADHD protocol can lower the requirements for self-organization and self-monitoring. As the population affected by ADHD has lower executive functioning, it is indispensable to have all the tools in one place. We should also mention the importance of commitment inside of the group of other users, group support, and the possibility of sharing the goals and the achievements and the constant memos that the program sent. The study supports the findings of Torous and colleagues (2018). On how mobile apps can be used on support or sometimes replace therapy.

**Figure 2** – The high-intensity group answers on two questions regarding the quality of life before the experiment



**Figure 3** – The high-intensity group answers on two questions regarding the quality of life after the experiment

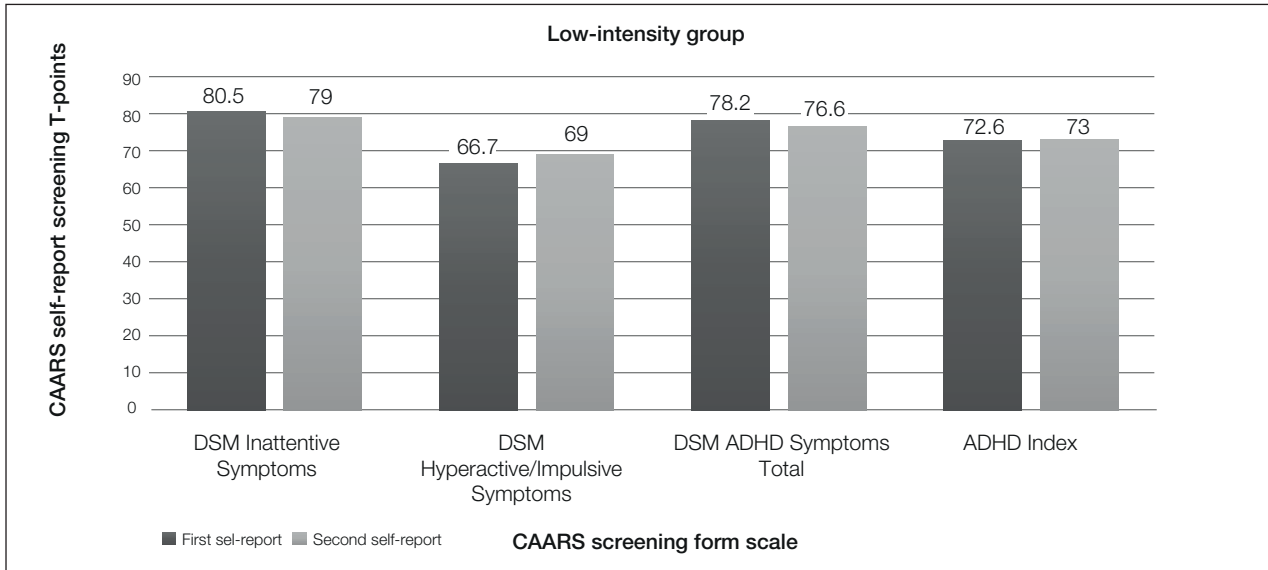


**Table 2** – The differences in low-intensity group pre- and post-experimental results

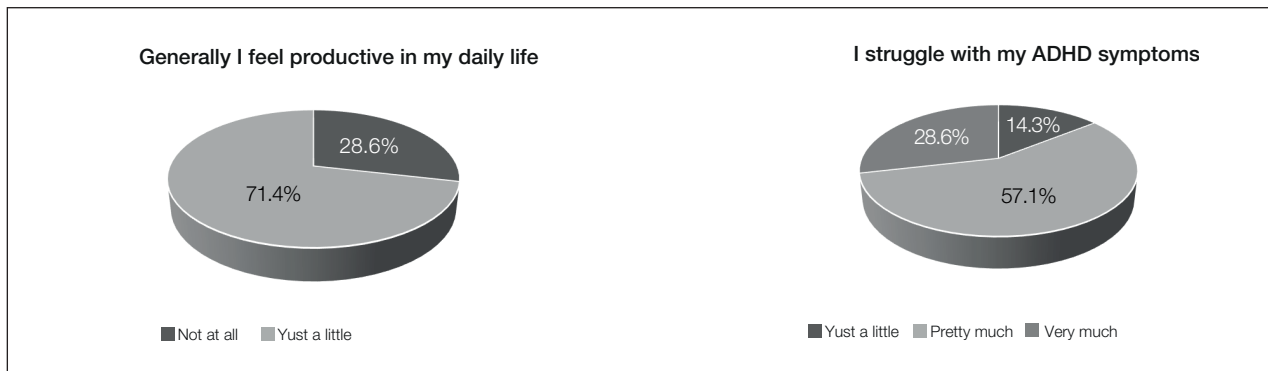
Source	<i>t</i>	<i>df</i>	<i>p</i>	<i>Cohen's D</i>
Inattentive symptoms	2.18	9	.028	
Hyperactive/impulsive symptoms	3.0	9	.007	.97
ADHD symptoms total	2.69	9	.012	.85
ADHD index	2.76	9	.035	.67
Generally, I feel productive in my daily life	-.55	9	.296	.17
I struggle with my ADHD symptoms	.8	9	.222	.16

*Legenda.* *df* = degree of freedom.

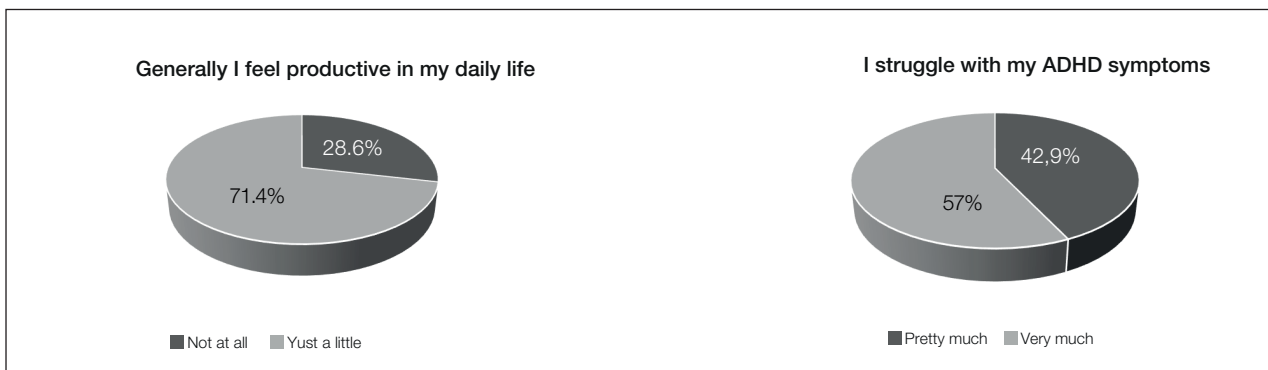
**Figure 4** – The difference between CAARS screening form results for the low-intensity group before and after the experiment



**Figure 5** – The low-intensity group responses on two questions regarding the quality of life before the control the experiment



**Figure 6** – The low-intensity group responses on two questions regarding the quality of life after using NUMO for 3 months



**Table 3** – Comparison of pre-experimental results of two groups

CAARS subscales	<i>F</i>	<i>p (F)</i>	<i>t</i>	<i>df</i>	<i>p (t)</i>	<i>Cohen's D</i>
Inattention	.75	.388	-.967	78	.168	.33
Hyperactivity/impulsivity	.01	.917	-.158	78	.437	.05
ADHD symptoms	.75	.387	-.646	78	.260	.21
ADHD index	.04	.837	-.404	78	.343	.13

*Legenda.* *df* = degree of freedom.

The study shows the effectiveness of programs aimed at developing new behavioural and cognitive skills in population affected by ADHD. Future development of similar tools can be beneficial for people with ADHD. Further research on people without ADHD who might want support in executive functions might amplify the possible application of this tool.

## Limitations of the study

One of them is the small number of participants in the low-intensity group. A randomized study with equal numbers of participants (higher than 50) could be performed

in the future to improve the generalizability of the findings. It was chosen to run a quasi-experiment that performed to observe natural behavioural patterns. However, due to the low number of participants in the low-intensity group, we were forced to use three separate analyses, including two sets of Student's *t*-tests for dependent samples and one set of Student's *t*-tests for independent samples.

Other future studies might focus on comparison of different mobile application. Such a study would help determine the most effective tools and give more information for its further development. Other parameters of effectiveness measurement, such as broader criteria of live quality and observer reports might be added it further research.

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