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Brazilian Portuguese Version of Intrinsic Motivation Inventory (IMI-Teq Br): Towards a Digital Well-Being Culture in Brazil

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Abstract Self-determination theory (SDT), a foundational psychological framework, has emerged as a pivotal lens through which to understand the dynamics of human-computer interaction (HCI) and Games User Research (GUR). Central to SDT is the conceptualization of intrinsic motivation, characterized by voluntary behaviors arising from personal interest. An established method for assessing intrinsic motivation across various contexts is the employment of the Intrinsic Motivation Inventory (IMI). This study presents a meticulous translation and cross-cultural adaptation of the 22-item version of IMI, known as the Task Evaluation Questionnaire, into Brazilian Portuguese (IMI Teq Br). The process adhered to the comprehensive methodology outlined by Beaton, encompassing Translation, Synthesis, Back-translation, Expert Committee review, and Pre-testing phases. Statistical analyses, including Student's T-test for independent samples, Exploratory Factor Analysis (EFA), and Confirmatory Factor Analysis (CFA), were conducted to ensure the validity and reliability of the translated instrument. Our findings corroborate the robustness of the adapted questionnaire, affirming its suitability for use within the Brazilian Portuguese-speaking context. This paper meticulously delineates the adaptation process and resultant statistical outcomes, offering insights into the significance of IMI Teq Br for engagement and motivation research grounded in SDT principles. Additionally, we thorougly discuss the challenges inherent to this context in Brazil, providing valuable considerations for future endeavors.

Keywords: self-determination theory, intrinsic motivation, self-report instrument, translation, cross-cultural adaptation

1 Introduction

The self-determination theory (SDT) is an empirical psychological theory of human motivation and personality [Ryan and Deci, 2017; Deci *et al*., 1994; Ryan *et al*., 2002]. Its popularity has increased in several areas, such as education, health, and technology, due to its characteristic of identifying the conditions that facilitate or hinder the motivation and satisfaction of a person [Ryan and Deci, 2017; Tyack and Mekler, 2020]. In human-computer interaction (HCI), SDT has proven relevant, especially in game studies, mainly because it provides a greater understanding of what constitutes an engaging experience, considered one of the main goals of this intersection of areas [Tyack and Mekler, 2020]. The main applications of the theory in HCI and game research have been investigating the motivational appeal of games, the player experience, game design construction, and industry evaluation [Tyack and Mekler, 2020].

The central concept described by SDT related to understanding user's engagement, behavior, and satisfaction within digital environments is *intrinsic motivation*, described as voluntary behaviors motivated by the person's interest and satisfaction [Ryan and Deci, 2020; Plant and Ryan, 1985; Ryan and Deci, 2017]. The relationship between motivation and User Experience (UX) lies in fulfilling basic psychological needs such as autonomy, competence, and relatedness. When these needs are met, it results in heightened motivation, increased engagement, and an enhanced user experience and overall well-being. Therefore, motivation is crucial in shaping UX [Hassenzahl, 2010]. By elucidating the intrinsic motivational users' drivers, SDT has significantly enriched our comprehension of user experience while serving as a cornerstone for designing more efficacious interactive systems and gaming experiences [O'Brien and Toms, 2010]. To measure intrinsic motivation in interactive applications, researchers have mainly used self-report instruments, such as questionnaires [Tyack and Mekler, 2020].

A systematic review conducted by Tyack and Mekler (2020) identifies two self-report questionnaires as most frequently used in studies considering SDT constructs in HCI [Tyack and Mekler, 2020]. The first is the Player Experience Need of Satisfaction (PENS) [Rigby and Ryan, 2007], which proposes measuring player experience elements in the following constructs: competence, autonomy, relatedness, controls, and presence/immersion. The second is the Intrinsic Motivation Inventory (IMI), a multidimensional instrument used to measure intrinsic motivation and self-regulation in general activities [Ryan and Deci, 2006]. IMI has a modular nature that allows smaller versions to be developed without losing their validity. One of these versions is IMI Task Evaluation Questionnaire (IMI-Teq) [Ryan and Deci, 2006], a 22-item version that measures the dimensions: interest/enjoyment, perceived competence, perceived choice, and pressure/tension.

However, akin to numerous psychometric self-report measures, IMI-Teq was originally formulated in English, thereby

restricting its validation solely to this linguistic context [Gerritsen *et al*., 2010; Miranda *et al*., 2021]. Consequently, its utilization among non-native English speakers cannot be deemed valid. Often, whenever validated translations are unavailable, researchers resort to ad-hoc translations of established instruments [Darin *et al*., 2023], potentially compromising the integrity of psychometric properties–a critical concern frequently overlooked within research endeavors [Miranda *et al*., 2021; Darin *et al*., 2023]. This oversight holds substantial implications for research outcomes, as the validity and reliability of data obtained through free translations remain dubious, transcending language barriers [Gerritsen *et al*., 2010]. Hence, the imperative for meticulous validation of translated instruments from a psychometric standpoint becomes evident, underscoring the need for methodological rigor to safeguard the integrity and credibility of research findings.

Expanding on the necessity for valid instruments, Miranda *et al*. (2021) emphasizes the importance of valid instruments in the Community of Portuguese Language Countries (CPLP), which has over 221 million speakers all over the world. The Grand Research Challenges in Games and Entertainment Computing in Brazil [Darin *et al*., 2023] delineate the foremost challenges confronting academia and industry within the gaming and entertainment domain over the ensuing decade. Particularly emphasized in Challenge 1–Augmenting the Body of Knowledge About Player Experience (PX)–is the imperative for translating and validating instruments into Brazilian Portuguese. Despite notable initiatives such as the development of instruments like MEEGA+ KIDS [von Wangenheim *et al*., 2018] and PX-BR [Aranha and Nunes, 2022], alongside translation efforts like SUS-BR [Lourenço *et al*., 2022] and UES-BR [Miranda *et al*., 2021], the majority of tools available for evaluating user experience (UX) and player experience (PX) constructs remain bereft of Portuguese translations. This deficiency in validated instruments in Portuguese casts doubt upon the integrity of user research studies employing self-measurement scales within this context, accentuating the necessity for translation and validation protocols to uphold methodological rigor and research credibility.

This paper presents the translation of IMI-Teq into Portuguese and its cross-cultural adaptation to the Brazilian context (IMI-Teq Br), keeping the original instrument's psychometric properties. To do so, we used the guideline proposed by Beaton *et al*. (2002) for translation and cross-cultural adaptation. To ensure the validity of the translated version, we performed statistical tests, namely, Student's T-test for independent samples, Exploratory Factor Analysis (EFA), and Confirmatory Factor Analysis (CFA). The IMI-Teq Br version was evaluated with good comprehension and evidence of validity and reliability.

This paper builds upon our previous work presented at the XXII Brazilian Symposium on Human Factors in Computing Systems (IHC'23) [Nunes and Darin, 2023], providing a thorough examination of the interplay among engagement, motivation, and well-being in HCI and GUR through the lens of SDT. It also delves into the nuanced revisions of IMI across its iterations and their relevance to our findings. Additionally, we provide a rationale underlying translation, localization, and cross-cultural adaptation processes, alongside a discussion of the associated challenges and limitations in our process. Moreover, we offer a concise manifesto advocating for a shift towards user experience (UX) design practices within the Brazilian context to foster a healthier digital future prioritizing user well-being. The translation and adaptation of IMI-Teq to the Brazilian context represents a step in this endeavor, recognizing that intrinsic motivation is just one aspect among several constructs of interest.

2 Background

HCI has historically evolved around promoting the quality of interaction for diverse contexts, objectives, and users' physical and psychological needs. Within this context, UX research focuses on fostering positive emotions and preventing negative ones related to technology use. The traditional approach to usability and UX encompasses functional, aesthetic, affective, and emotional aspects associated with the pursuit of pleasure, satisfaction, and immediate positive emotions. However, experiences that promote long-term fulfillment and promote intrinsic motivation and self-determination are rarely addressed in the design and evaluation of interactive systems.

This Section explores the conceptual framework surrounding these concepts, which are fundamental to SDT and, hence, to the implications of IMI-Teq Br for the design and evaluation of digital applications. It also summarizes the history of IMI's development to assess intrinsic motivation and the approaches to translate psychometric self-report instruments

2.1 Theoretical Perspective

In this section, we delve into the psychological theories underpinning the concepts of well-being, focusing on Hedonia, Eudaimonia, and SDT. Furthermore, we present the dynamics of intrinsic motivation and its impact on engagement, emphasizing the importance of designing technologies that foster long-term well-being.

2.1.1 Hedonia, Eudaimonia and Self-Determination Theory

The concept we characterize as "well-being," understood as the optimal psychological experience and functioning, has been understood differently throughout history. Currently, two main lines that support different perceptions of happiness and well-being would be [Deci and Ryan, 2008], Hedonia – traditionally associated with UX design and research – and Eudaimonia. In the hedonic perspective, based on the general social science theory, the presence of positive affections and the absence of negative affections represents well-being. On the other hand, Eudaimonia relates to an individual having a latent potential and that happiness, or the state of well-being, would be achieved through the profound experience of this potential. While hedonic experiences are more related to momentary pleasure, eudaimonic experiences relate to need satisfaction, feelings of significance, and positive

affect [Stephanidis *et al*., 2019]. According to Deci and Ryan (2008), Hedonia limits the perception of well-being and does not contemplate the various aspects of human subjectivity. Yet, the emphasis of UX on hedonic aspects has overshadowed the importance of eudaimonic aspects of well-being, which can lead to significant harm caused by technologies in different contexts.

In this scenario, there has been a recent effort in the HCI field to work on the design of technologies more focused on long-term well-being, promoting eudaimonic experiences [Stephanidis *et al*., 2019]. This is due to advances in user experience regarding emotional and more pleasure-oriented aspects, and by positive psychology [1] that promotes positive human development. However, one of the concerns regarding well-being and eudaimonia is the lack of practical implementation for the merging of positive psychology and interaction technologies. Therefore, a crucial requirement arises in HCI to shift focus toward a more actionable approach to incorporate aspects of eudaimonia into the user experience, which has been termed user eudaimonia. Nevertheless, one of the greatest difficulties of this convergence of areas concerns measuring these concepts since human eudaimonia is completely subjective.

Some psychological theories of eudaimonia, based on humanistic psychology, have been studied, such as the broaden-and-build theory of positive emotions, which suggests that cultivating positive emotions enhances coping behavior [Sirgy, 2002]. Another theory is the Self-Determination Theory (SDT), an empirical psychological theory of human motivation and personality that seeks to understand how biological, social, and cultural factors affect humans' capacities for psychological growth, engagement, and well-being [Ryan and Deci, 2017]. It suggests that the processes of motivation and well-being are enhanced by the satisfaction of three basic psychological needs - autonomy, competence, and relatedness.

SDT is organized into six mini-theories, each with propositions of critical concepts for understanding and explaining phenomena related to motivation or personality functioning, these being:

- **Cognitive Evaluation Theory (CET)**
  Describes the processes by which the social context positively or negatively influences intrinsic motivation and, in turn, an individual's performance and well-being.
- **Organismic Integration Theory (OIT)**
  Concerns both the social factors that promote or inhibit internalization and the integration of social and cultural regulations that influence extrinsic motivation.
- **Causality Orientations Theory (COT)**
  Describes individual differences in people's tendencies to orient depending on the environment and delineates three types of causality orientations: the autonomy orientation, in which people act out of interest and appreciation; the control orientation, in which the focus is on rewards; and the motivated orientation characterized by anxiety about competence.
- **Basic Psychological Needs Theory (BPNT)**
  Details how the dynamics of basic needs promote or frustrate the individual's well-being and vitality, regardless of the context in which he or she is inserted.
- **Goal Contents Theory (GCT)**
  Describes the concerns about the individual's goals and their relationship to basic needs and well-being satisfaction.
- **Relationships Motivation Theory (RMT)**
  Specifies how interpersonal relationships, both between individuals and within groups, depending on individuals' ability to experience positivity or consideration and respect for autonomy.

[1] Positive psychology is understood as the study of the conditions and activities that promote optimal functioning in individuals [Gable and Haidt, 2005].

2.1.2 Intrinsic Motivation

According to Ryan and Deci (2017), etymologically, motivation is an energy that moves people to action. Theories in psychology that seek to analyze this phenomenon focus on aspects that enhance or guide motivational behavior, viewing the concept as a single entity without separation. SDT differs by categorizing motivation into types and sources that impact behavior dynamics [Ryan and Deci, 2017].

The theory suggests that some forms of motivation may be voluntary, reflecting the person's internal features, such as values and interests, and external factors may influence others. The drivers of this motivation may vary in magnitude, experiences of the individual, and behavioral consequences, such as health benefits. SDT establishes an internal dimension called the autonomy-control continuum to differentiate between the types of motivation. When autonomous, behaviors are described as self-expression, while controlled behaviors are those in which a person feels externally or internally pressured to act. For example, a person is controlled when his motivations to act are based on feeling coerced by outsiders.

Cognitive Evaluation Theory (CET), the first mini-theory of SDT, defines the idea of intrinsic motivation. Intrinsically motivated behaviors are performed out of the person's interest, and feelings such as pleasure and competence are considered the primary "reward." These behaviors are voluntary, emanating from the person and are understood as an inherent human propensity. Some activities highlighted by SDT authors as typical of intrinsic motivation are sports and gaming [Ryan and Deci, 2017]. However, it is important to emphasize that each individual may be intrinsically motivated by some activities and not by others, and only in specific social contexts. Thus, to assess intrinsic motivation, one must consider how the person experiences the characteristics of activity and context.

Hence, Deci and Ryan's Intrinsic Motivation Inventory (IMI) is a pivotal tool in operationalizing the construct of intrinsic motivation, offering a comprehensive framework for evaluating individuals' intrinsic motivation levels within diverse activities and settings. Its development marks a significant contribution to the understanding and measurement of motivational dynamics. In HCI, integrating insights gleaned from motivational theories holds substantial promise. By incorporating these principles into the design and development of interactive systems, practitioners stand to craft technology

that not only captivates users but also aligns with their innate drives and aspirations. Such an approach fosters the creation of more engaging, user-centric digital systems that resonate with individuals on a deeper level.

2.1.3 Engagement, Motivation and the Engagement-Addiction Dilemma

One of the UX and PX constructs often associated to motivation in the HCI and GUR literature is engagement. Engagement is the quality of the user experience characterized by the depth of the interaction between the user and the system, which goes beyond satisfaction [Miranda *et al*., 2021]. It is understood as a global goal in the design of content, products, systems, and services. It has been used in identifying UX, student motivation, and the construction of technologies related to well-being [Doherty and Doherty, 2018]. In the context of games and gamified applications, player engagement is a determining factor for the application's success. It contributes to the understanding of different constructs related to PX, thus being strongly investigated at the intersection of HCI and game studies. [Miranda *et al*., 2021]

Engagement has been defined in different ways in the literature as a multifaceted construct that includes motivation as one of the determining factors in its identification, sometimes having its concepts interchanged in research [Doherty and Doherty, 2018]. In 1996, Jacques defined engagement as a user's response to the interaction that gains, maintains, and encourages their attention, especially when they are intrinsically motivated. This definition influenced the later work of [O'Brien and Toms, 2008], which describes engagement as a quality of UX with technology characterized by motivation, challenge, aesthetic, and sensory appeal, among others. In [Zyngier, 2008], the author describes engagement as a mixture of behavioral, emotional and cognitive factors, with motivation being a component of the group of cognitive factors that influence engagement. In this sense, as a theory of motivation and well-being, SDT is also related to engagement. By describing the three basic needs for promoting well-being – Autonomy, Competence, and Relatedness –, SDT provides key points for explaining the relationship between engagement, motivation, and well-being with independent variables such as design features.

While engagement is often regarded as a positive attribute contributing to user well-being, particularly within the realm of digital gaming, it is crucial to acknowledge the potential negative impacts associated with efforts to promote engagement, including the development of addictive behaviors [Peters *et al*., 2018; Miranda and Darin, 2022]. Research in digital games and media consumption has demonstrated that excessive engagement can impede healthy activities, thereby compromising overall well-being [Peters *et al*., 2018]. The World Health Organization (WHO) recognizes two disorders linked to excessive engagement in its International Classification of Diseases (ICD). Firstly, Gaming Disorder is characterized by a loss of control over gaming behaviors, with gaming taking precedence over other daily responsibilities [Stevens *et al*., 2021]. Secondly, Screen Dependency Disorder serves as an umbrella term encompassing various screen-related addictions such as Internet Addiction Disorder (IAD), Mobile Phone Dependence (MPD), and Internet Gaming Disorder (IGD) [Sigman, 2017]. These findings highlight the importance of understanding the nuanced relationship between engagement and well-being in digital contexts and addressing potential risks associated with excessive engagement. Through continued research and awareness efforts, strategies can be developed to mitigate these negative consequences and promote healthier interactions with digital technologies – and assessing intrinsic motivation in digital interaction is necessary for that.

The dilemma between generating engaging but non-addictive behaviors has been studied in the literature under the engagement-addiction dilemma [Charlton and Danforth, 2010; Yang and Gong, 2021]. According to [Charlton and Danforth, 2010], the difference between the constructs of addiction and engagement is due to the final consequences, positive or negative, of the person's behavior. Although two people can engage equally in behavior, one can be considered addicted because they encounter negative consequences. In contrast, the other can be considered engaged because they do not suffer negative consequences. This dilemma in digital games, although still little explored by academia [Yang and Gong, 2021], has fostered discussions about the exploration of game design features that offer engagement to the player, but which in turn generate the obsessive and addictive use of games [Yang and Gong, 2021]. In addition to games, this phenomenon has also been observed in the use of social networks and smartphones [Yang and Gong, 2021].

Despite the importance of this issue, further research is still needed to understand the dilemma dynamic and develop strategies to mitigate its negative effects while fostering engaging experiences. The translation of instruments such as IMI-Teq can provide input for the Brazilian scientific community to delve into this issue, contributing to the international research scene by offering insights into cultural influences on motivation and addictive behaviors. By incorporating measures of intrinsic motivation into studies on the engagement-addiction dilemma, researchers can guide the development of strategies that prioritize user well-being while maintaining the desired experience design.

2.2 The Intrinsic Motivation Inventory (IMI)

The Intrinsic Motivation Inventory (IMI) is a multidimensional self-report questionnaire proposed to measure motivation [Ryan and Deci, 2006]. The instrument is used in many researches to measure the intrinsic motivation and self-regulation dimensions related to self-determination theory, as seen in [Ryan, 1982; Ryan *et al*., 1983; Plant and Ryan, 1985; Ryan *et al*., 1990, 1991; Deci *et al*., 1994].

IMI assesses the motivation construct by measuring the underlying factors of interest/enjoyment, perceived competence, effort, value/usefulness, felt pressure and tension, perceived choice, and relatedness, yielding seven scores. The full version of the IMI, named The Post-Experimental Intrinsic Motivation Inventory, is composed of 45 items divided into the seven dimensions assessed.

Smaller versions of the questionnaire have been used in research to assess more specific dimensions or adapt to different activity contexts. We chose the 22-item version of IMI,

called the Task Evaluation Questionnaire (IMI-Teq), which focused on measuring intrinsic motivation in more general activities. The instrument uses a 7-point Likert scale divided into four dimensions: interest/enjoyment, perceived choice, perceived competence, and pressure/tension, dimensions proposed as determinants for motivation assessments. Despite the reduction of items, as happens in IMI-Teq, the overall psychometric properties of IMI are kept stable [Ryan and Deci, 2006].

The relevance of IMI in in HCI and digital games research can be seen in the systematic review by Tyack and Mekler [2020], which aimed to understand the motivations and effects of using SDT in games and HCI research. The authors selected 110 full papers published at the ACM Conference on Human Factors in Computing Systems (CHI) and ACM SIGCHI Annual Symposium on Computer-Human Interaction in Play (CHI PLAY) conferences between 2009 and 2019. Among the selected papers, 24 distinct research areas were identified. The authors highlight the main ones: (i) studies on player experience (61.82%), (ii) design and interaction techniques (21.82%) and gamification (18.18%).

According to the authors, the IMI was used in 40% of the selected works, with almost half of them lacking explicit motivations for its use. However, some justifications for its application can be found in the papers. Notable reasons include its proven utility in other HCI and gaming studies, its modular structure that allows for independent validation, and its ability to complement findings from other metrics such as questionnaires and interviews. Additionally, the authors present the Player Experience Need of Satisfaction (PENS) questionnaire as another instrument most frequently cited among the selected papers, appearing in approximately 40% of then.

The IMI questionnaire has undergone significant revisions since its original conception [Markland and Hardy, 1997; Fonseca and de Paula Brito, 2001]. The question of authorship remains debated among researchers, although it is widely believed that the items comprising the IMI were first published in the work of McAuley *et al*. (1989). Initially, the questionnaire encompassed four dimensions: interest/enjoyment, perceived competence, effort/importance, and pressure/tension. Over the years, other dimensions were included in IMI to improve its utility, for example the perceived choice dimension, which aligns with the construct of perceived locus of causality derived from the cognitive evaluation theory [Markland and Hardy, 1997; Fonseca and de Paula Brito, 2001].

The addition of items to IMI over time has raised concerns, especially regarding redundancy within the instrument [Ryan and Deci, 2006], since it is stated that items within the dimension considerably overlap. Nevertheless, to decrease this problem, shorter versions of IMI have been developed, as presented in the previous section, and they offer a practical solution while maintaining the reliability of IMI's measurement. The continuous evolution and adaptation of IMI have contributed to its robustness and versatility as a measurement tool for intrinsic motivation across various contexts. These developments ensure that the inventory remains relevant and effective in capturing the multidimensional nature of intrinsic motivation

2.3 Questionnaire's Translation and Cross-cultural Adaptation

Several studies have translated and adapted psychometric questionnaires for different languages and areas, usually following translation, localization, and cross-cultural adaptation. In general, these processes can be defined as follows:

- **Translation**
  A communicational process based on changing texts from an original language to a different language [Munday *et al*., 2022]. For example, if a questionnaire were initially developed in English and translated into Spanish, each item would be accurately translated to maintain its intended meaning;
- **Localization**
  The process of modifying a product for a specific location by combining the target language, thus encompassing the translation process, with adding the sociocultural implications of the geographic/demographic region for which it is intended [Yunker, 2002]. For instance, a questionnaire about customer satisfaction for a product might need localization when used in different regions to reflect cultural differences in consumer behavior and preferences;
- **Cross-cultural adaptation**
  The process of adapting a questionnaire constructed in a given language to another language and culture, focusing mainly on the cultural characteristics of the two languages and including the validation of its psychometric properties [Beaton *et al*., 2002]. For example, if a psychological assessment tool developed in the United States is being adapted for use in Japan, researchers would assess whether the questionnaire items are culturally appropriate and meaningful within the Japanese cultural context.

Overall, the translation and cross-cultural adaptation of questionnaires require meticulous attention to linguistic, cultural, and psychometric factors to maintain the integrity and validity of the instruments across diverse populations and contexts. In the case of the IMI-Teq, this process involved not only linguistic translation but also careful consideration of cultural nuances and the validation of psychometric properties specific to the Brazilian Portuguese-speaking population. Through rigorous adherence to established guidelines and comprehensive validation procedures, the IMI-Teq was successfully adapted to ensure its effectiveness in assessing intrinsic motivation within the Brazilian cultural context.

3 Methodology

This study was approved by the Research Ethics Committee of the Federal University of Ceará (CAAE No. 56151422.4.0000.5054). To ensure ethical practices, the volunteers were provided with detailed verbal and written information regarding the study, and they signed a consent form indicating their willingness to participate. We conducted the study in two phases: (i) translation and cross-cultural adaptation, and (ii) statistical tests, including T-test for independent

samples, exploratory factor analysis, and confirmatory factor analysis. Each step of the process is thoroughly explained in the following sections.

It is important to highlight that most of this research was produced between November 2021 and June 2022, where we are coming out of a pandemic period caused by the new coronavirus (Sars-CoV-2) that has social distancing as the main preventive measure. In this scenario, we have chosen to use hybrid methods, giving priority to the remote context as a way to decrease possible risks. Thus, phases such as participant recruitment and execution of the remote activities presented challenges typical of this context.

3.1 Translation and Cultural Adaptation

In the first phase, we followed the guideline proposed by Beaton *et al*. (2002) for translation and cross-cultural adaptation of health state measures. The guideline is divided into five steps, described as follows:

1. **Initial translation:** The instrument is directly translated by two native speakers of the target language. To enhance the translation process, one of the translators must have knowledge about the specific concepts evaluated by the questionnaire. As a result, two distinct versions of the translation are generated in the target language, labeled as T1 and T2.
2. **Synthesis:** The two translators and an observer meet to synthesize the two translations generated, thus generating the T12 version. A written report of the discussion should be made.
3. **Back-translation:** Two native speakers of the instrument's language should translate the T12 version back into the source language. The two translators should not know anything about the source instrument or the constructs being measured by it. As results, two versions are produced, labeled B1 and B2.
4. **Expert comittee:** A meeting is organized to deliberate on the T12 version, along with the other versions generated throughout the process (source, T1, T2, B1, and B2), and the report created in step two. To ensure a thorough discussion, all four translators involved in the previous steps, along with a linguistic professional, a technology professional, and a methodologist, are expected to attend. The outcome of this meeting is the development of the pre-final version.
5. **Pretesting (Evaluation of the translation):** Data is collected to evaluate the target audience's understanding of the pre-final version generated in the previous stage, with a sample of 30 to 40 participants.

The profiles of participants in this phase were intentionally selected through non-probabilistic purposive sampling, considering specific characteristics required for each participant's profile. The summarized details are presented in the Table 1. In the initial translation stage, two Brazilian Portuguese speakers translated the source version of IMI-Teq into Brazilian Portuguese, producing versions T1 and T2. Both translators have opposite profiles, being the T1 version produced by a professional in the HCI area, with experience with the concepts used in the questionnaire, and the T2 version by a specialist in the linguistic area with no experience in the HCI area, nor was he informed about the concepts used in the questionnaire.

The T1 and T2 versions were later merged into a version called T12, which was sent for back-translation. Version T2 had a more concise language and adhered to a more consistent sentence structure. As a consequence, most of the phrases in Version T12 came from Version T2. The back-translation focus on translating the T12 version (Brazilian Portuguese) back to the source language (English) and was performed by two native English speakers, one of them being a British English speaker and the other an American English speaker. The versions resulting from this stage are called B1 and B2. In version B2, the translator used simpler verb tenses and more concise expressions than version B1, which made the sentences clearer and more direct.

Next, all the translations produced so far (T1, T2, T12, B1 and B2) were analyzed by an experts committee, formed by all the translators from the previous stages, a technology professional working in the field of HCI, and a professor of Psychology. This step resulted in the so-called pre-final version, which went through a comprehension analysis with 31 volunteers from the target audience, amount considered within the ideal sample range of 30 to 40 people Beaton *et al*. [2002]. The selection criteria for participants were to: (i) Be over 18 years old, (ii) Have completed elementary school, (iii) Be a native Brazilian Portuguese speaker, and (iv) Be unfamiliar with the source version of IMI-Teq.

We conducted the pre-test partially in a usability lab at the Federal University of Ceará and partially online using the Google Meet tool. Each session had an average of 20 minutes, being conducted by a researcher and had the following procedures: (i) Contextualization about the project, (ii) Explanation and signing of the term of informed consent, (iii) Application of a socio-demographic questionnaire, (iv) Application of the IMI-Teq Br pre-final version, using a 7-point likert scale, (v) Application of the comprehension scale, using a 5-point likert scale, and (vi) Application of a semi-structured interview to collect feedback on words, sentences and expressions used in the translation.

To apply the pre-final version of the IMI-Teq Br, we asked participants to describe a motivating or demotivating experience with a digital product and, thinking about this experience, to fill out the IMI-Teq Br. The comprehension scale was adapted from Conti *et al*. [2009], where for each questionnaire item, the question "What do you think of this sentence?" was answered on a 5-point Likert scale. We modified the scoring range from 0 to 4 to 1 to 5, where: 1 - I did not understand anything; 2 - I understood a little; 3 - I understood more or less; 4 - I understood almost everything but had some doubts; 5 - I understood everything and had no doubts.

During this stage, we identified comprehension issues in certain items related to the subscale of perceived choice. Recognizing this concern, the expert committee implemented necessary adjustments. Additionally, it came to our attention that a majority of participants who encountered comprehension difficulties were evaluating digital games. Consequently, during the questionnaire validation phase, we conducted statistical tests to gather evaluations specifically for

Table 1. Summary of the participants' profiles

Step	Required profile	Participant's information
1) Initial Translation	The translator should be aware of the concepts being examined in the questionnaire.	Gender: Female First language: PT-BR Graduation Field: Computer Science Occupation: Associate Professor Professional experience: 10 years
	The translator should neither be aware nor be informed of the quantified concepts (i.e., naive translator)	Gender: Male First language: PT-BR Graduation Field: Linguistics Occupation: English Teacher Professional experience: 26 years
2) Synthesis	Same profiles from the first step	Same profiles from the first step
3) Back-translation	Naive-translator whose mother-tongue is English. They should neither be aware of the source version of the questionnaire nor be informed of the concepts being quantified.	Gender: Female First language: en-US Graduation Field: Communication Occupation: Admissions Officer and Travel Specialist at an international school Professional experience: 7 years
		Gender: Male First language: en-GB Graduation Field: Business and Systems Transformation Occupation: Retired Professional experience: 31 years
4) Experts committee	All profiles from the previous steps	Same profiles from the first and third steps
	Linguistics professional	Same profile of the naive translator from the first step
	Technology professional	Gender: Female First language: PT-BR Graduation Field: Digital Media and Systems Occupation: Interaction Designer Professional experience: 5 years
	Methodologist	Gender: Male First language: PT-BR Graduation Field: Psychology Occupation: Associate Professor Professional experience: 14 years

digital games, aiming to discern any unique aspects associated with the perceived choice subscale when applied to this particular type of application. The results of the pre-final version's comprehension test and modifications proposed by the experts comitee are presented in Section 4.

3.2 Statistical tests

For this phase, we followed the method used by Kortum and Bangor (2013), Blažica and Lewis (2015) and more recently by Miranda *et al*. (2021) of providing meaning to the questionnaire scores by comparing two groups of data based on people's prior experiences.

3.2.1 Participants

We recruited the participants (N=300) using online platforms and social media channels, including Instagram, Whatsapp, Telegram, Facebook, and email. The selection criteria required participants to be over 18 years old, have completed elementary school, be native Brazilian Portuguese speakers, and be unfamiliar with the source version of IMI-Teq.

3.2.2 Data collection

To gather data on motivating and demotivating experiences in digital products and games, we used two separate online forms. In the first form, participants provided ratings of their experiences with a specific task within a digital product, such as a website, application, or software, in which they felt motivated or demotivated. The second form had the same objective but focused on evaluating experiences within digital games. Both forms incorporated questions to collect sociodemographic data, describe the chosen digital product/game, and assess the experience of the task using a randomized version of IMI-Teq Br.

3.2.3 Data labeling and Segmentation

Upon collection, the data was categorized into two subsets: "Motivating Experiences (ME)" (N=150) and "Demotivating Experiences (DE)" (N=150). Additionally, the data was further divided into four subcategories to facilitate a comparative analysis: "Motivating Game Experiences (MGE)" (N=75), "Demotivating Game Experiences (DGE)" (N=75), "Motivating Digital Products Experiences (MPE)" (N=75), and "Demotivating Digital Products Experiences (DPE)" (N=75).

3.2.4 Analysis

In order to achieve the validation of IMI-Teq Br, the collected data was subjected to the following statistical tests:

1. **T-test for independent samples**
   We conducted a T-test for independent samples to determine if there was a significant difference in IMI-Teq Br scores between evaluating motivating and demotivating experiences. The Interest/Enjoyment subscale was hypothesized to score significantly higher in evaluating motivating experiences, while the Pressure/Tension subscale was expected to yield higher scores in evaluating demotivating experiences.
2. **Exploratory Factor Analysis (EFA)**
   An exploratory factor analysis with Oblimin rotation and minimum residuals extraction method was performed to identify underlying factors in the data.
3. **Confirmatory Factor Analysis (CFA)**
   We conducted a confirmatory factor analysis (CFA) to test the 4-factor structure and reliability of IMI-Teq Br. We used the maximum likelihood robust estimator (MLR) for this analysis. Goodness-of-fit indices, including Chi-square (χ^2; $p \leq .05$), Comparative Fit Index (CFI$\geq$.90, acceptable, and $\geq$.95, desirable), Tucker-Lewis Index (TLI$\geq$.90, acceptable, and $\geq$.95, desirable), and Standardized Root Mean Square Residual (SRMR$\leq$.08, good fit), were employed to assess the model fit.
4. **Reliability assessment**
   The reliability of IMI-Teq Br was evaluated using Cronbach's alpha (α) and McDonald's omega (ω), widely recognized measures of reliability in behavioral science research.

4 Results

This section presents the data analysis of the (i) comprehension of the pre-final version and (ii) statistical tests.

4.1 Compreehension of the pre-final version

The IMI-Teq Br comprehension assessment had 31 participants, with 24 from the technology field (11 male, 9 female, 1 agender, 1 non-binary and 2 non-declared) and 7 from other areas (3 male, 3 female and 1 non-declared). The age range of the first group (technology field) was 22 to 34 years, having as mean 26.25, and the age range of the second group (non-technology field) was 18 to 28 years, having as mean 23.28. Most of the participants are at the undergraduate level, being 17 from the technology area and 4 from other fields. The level with the smallest sample was the doctoral level, with only one participant from the technology area.

All participants evaluated the IMI-Teq Br positively. In the technology field group of participants, 83% of all items were understood without question, while the non-technology field group completely understood 95% of all items. Both Interest/Enjoyment and Perceived Competence subscales had 90% comprehension on their items, while the Perceived Choice scale had 71% total comprehension of its items. The Pressure/Tension scale had 87% comprehension. The mode and median of all responses was 5 - "I understood everything, and had no questions," as shown in Table 2 that presents the descriptive statistics of the IMI-Teq Br comprehension test.

Table 2. Descriptive statistics for the prefinal test (N=31).

Q	M	SD	Var	Min.	Mdn.	Max.	ModeN/Mode	
Q1	4,70	0,64	0,41	4	5	5	5	30
Q2	4,54	0,76	0,58	3	5	5	5	28
Q3	4,70	0,64	0,41	4	5	5	5	30
Q4	4,90	0,3	0,09	3	5	5	5	26
Q5	4,80	0,65	0,42	4	5	5	5	30
Q6	4,93	0,24	0,06	2	5	5	5	28
Q7	4,61	0,80	0,64	3	5	5	5	27
Q8	4,96	0,17	0,03	2	5	5	5	24
Q9	4,96	0,17	0,03	4	5	5	5	30
Q10	4,70	0,78	0,61	1	5	5	5	22
Q11	4,16	1,03	1,07	3	5	5	5	29
Q12	4,96	0,17	0,03	4	5	5	5	30
Q13	4,87	0,42	0,18	3	5	5	5	28
Q14	4,96	0,17	0,03	4	5	5	5	30
Q15	4,77	0,56	0,31	3	5	5	5	26
Q16	4,96	0,17	0,03	4	5	5	5	30
Q17	4,77	0,76	0,58	2	5	5	5	28
Q18	4,80	0,54	0,29	3	5	5	5	27
Q19	4,48	1,06	1,12	2	5	5	5	24
Q20	4,96	0,17	0,03	4	5	5	5	30
Q21	4,54	0,88	0,78	1	5	5	5	22
Q22	4,90	0,39	0,15	3	5	5	5	29

Some participants, however, had problems with some items on the Perceived Choice subscale, specifically items 11 (15 participants), 19 (8 participants), and 21 (9 participants). Most of these participants answered the IMI-Teq Br thinking about a task within a digital game. During the interview, they reported that these items did not fit the task they chose since they had a choice about whether or not to perform the task, as it was their choice to play the game. This drew our attention to the possibility that digital games have a specificity when it comes to assessing choice/control in a task, a central point of the Perceived Choice subscale.

Considering this, we separated the data collection for the statistical analysis in two forms, one for interactive products in general (e.g. websites, applications) and another for digital games, to verify if the scores of this subscale presented considerable differences.

The expert committee made adjustments after analyzing the comprehension data, resulting in the final version of IMI-

Teq Br, presented in section 5. These adjustments focused on enabling task filling on each item to fit specific activities. This change was also intended to help in the understanding of the items noted with some level of doubt on the Perceived Choice subscale, presenting more context to the participant. According to Ryan and Deci (2006), this practice is often performed when using the questionnaire and does not affect its reliability or validity. Another adjustment made concerns the removal of item 17 from the questionnaire. Although in the source version items 5 "I found the task very interesting" and 17 "I thought the task was very interesting" were different, the translation into Brazilian Portuguese was the same: "Achei a tarefa muito interessante." In the discussions raised by the committee participants, no reasons were found to change the result of the two original sentences, so it was decided to remove them.

Although there were some doubts in those few items, the qualitative and quantitative data analysis showed a shared understanding of the IMI-Teq Br items. All participants stated that the prefinal version was easy to understand and fast to score.

4.2 T-test for independent samples

The number of responses from the two forms gave a total of 300, with 150 referring to motivating experiences (ME) and 150 referring to demotivating experiences (DE). Among the most frequently cited games in motivating experiences are: League of Legends, Free Fire, and games from the Mario and Pokémon franchises. As for digital products, the most frequently cited in motivating experiences are social media apps (Facebook, Instagram, TikTok, WhatsApp), educational apps (Duolingo), and utilities smartphone apps. The most cited game in the demotivating experiences was League of Legends and among the other types of digital products, the most cited were social media apps (Instagram and Facebook) and productivity applications.

The characterization of the samples are presented in Tables 3 and 4, separated by the type of experience evaluated. The majority of participants are male, being 80 in ME and 76 in DE against 62 in ME and 57 in DE of female participants. A small portion of the participants (ME=8, DE=7) identified with other genders or preferred not to state their gender. The average age of the participants was 26 in ME versus 31 in DE. Most of the participants are from the technology area, being 172 participants in both experiences (78 in ME and 94 in DE) against 128 from other fields (72 in ME and 56 in DE). To apply the T-test on the collected data sample, we first calculated the score of each subscale of IMI-Teq Br. Initially, the scores of items 2, 9, 11, 14, 18, and 20 were reversed by subtracting 8 from the original score [Ryan and Deci, 2006]. Next, the average of the items of each subscale was taken, thus generating 4 scores.

A higher score in a subscale indicates more of that concept described in its name. Thus, a higher score on the Pressure/Tension subscale indicates that the person felt more pressured or tense while doing the task, and so on. This can be seen in our T-test results (see Table 5), where the mean of the scores in the Interest/Enjoyment subscale, considered the real measure of intrinsic motivation, and Perceived Competence and Perceived Choice subscales, considered positive predictors of intrinsic motivation, are significantly higher in motivating experiences (6.19 in Interest/Enjoyment, 5.54 in Perceived Competence and 5.31 in Perceived Choice, while Pressure/Tension has 3.39). Similarly, in the DE scores the Pressure/Tension subscale, considered the negative predictor of intrinsic motivation, scored higher (1.95 in Interest/Enjoyment, 3.09 in Perceived Competence and 3.62 in Perceived Choice, while Pressure/Tension has 4.80). Thus, we have a statistic indication that motivating and demotivating experiences are being evaluated accordingly when using IMI-Teq br. The analysis of T-tests conducted separately for games and digital products revealed similar results.

Table 3. Motivating experiences - Sample characterization

Gender	Male	80	($\cong 53\%$)
	Female	62	($\cong 41\%$)
	Other/Non-declared	8	($\cong 6\%$)
Age	Mean	26,946	
	SD	5,844	
	Min - Max	19 - 59	
Graduation/ Professional Field	Technology	78	
	Other areas	72	

Table 4. Demotivating experiences - Sample characterization

Gender	Male	76	($\cong 51\%$)
	Female	57	($\cong 45\%$)
	Other/Non-declared	7	($\cong 4\%$)
Age	Mean	31,753	
	SD	7,738	
	Min - Max	19 - 58	
Graduation/ Professional Field	Technology	94	
	Other areas	56	

Table 5. Results of T-test to independents samples.

Subscale	Mean		SD		T-test Report
	ME	DE	ME	DE	
Interest Enjoyment	6,19	1,95	0,95	1,13	t(298) = 35.2 p <.01
Perceived Comp.	5,54	3,09	1,48	1,59	t(298) = 13.8 p <.01
Perceived Choice	5,31	3,62	1,17	1,44	t(298) = 11.2 p <.01
Pressure Tension	3,39	4,80	1,46	1,36	t(298) = -8.63 p <.01

4.3 Exploratory Factor Analysis (EFA)

The factor loadings of the EFA are presented in Table 6. We evaluated the adequacy of the sample using the Kaiser-

Meyer-Olkin (KMO) measure of sampling adequacy. The overall KMO value was .920, indicating that the sample is considered adequate since values above .5 are acceptable, and values above .9 are optimal Dodge [2008]; Vogt and Johnson [2011]. Additionally, several items presented excellent KMO values, including IE1 (0.957), IE5 (0.952), IE8 (0.956), IE14 (0.955), IE19 (0.953), PC4 (0.924), PC7 (0.938), PC12 (0.929), PC16 (0.913), PC21 (0.918), PCH3 (0.928), PCH15 (0.908), and PT9(0.953). The lowest value was for item PT17 (0.716), which still falls within the range of adequacy. We also conducted Bartlett's Test of Sphericity ($\chi^2 = 5472$, df = 210, $p < 0.001$). These findings confirm that the correlation matrix is not an identity matrix, indicating the presence of significant correlations among the variables. Therefore, our hypothesis of sphericity was not supported, suggesting that the EFA is an appropriate approach for assessing the underlying structure of our data.

EFA showed some cross-loadings, similar to the ones idenyified in previous research Ryan and Deci [2006], indicating that some items considerably overlap. For example, items PCH3 (.37 on Perceived Choice) and PT17 (.58 on Pressure/Tension) loaded on other two factors (.32 on Perceived Competence, and -.37 on Perceived Choice, respectively). There were also items PCH15 and PT9, which loaded weakly on their original factor, but loaded heavily on other factors (PCH15 loaded .33 on Interest/Enjoyment and .42 on Perceived Competence, and PT9 loaded -.59 on Interest/Enjoyment). These cross-loadings can be explained by examining the correlation matrix of IMI-Teq Br factors in Table 7, which showed that the factors Interest/Enjoyment, Perceived Competence, and Perceived Choice are positively correlated with each other (ranging from .31 to .68). On the other hand, Pressure/Tension presented a negative correlation with these factors, reinforcing the idea that it is a negative predictor of IMI Ryan and Deci [2006]. We examined these items in the CFA to check if the cross-loadings could be an indication of unreliability of the 21-item model, but this did not prove true, as explained in the next section – although it indicates the model could be improved.

The Exploratory Factor Analysis conducted separately by games and digital products showed no difference from that conducted jointly, with no significant change. The 4-factor structure remained the same, and the cross-loadings were similar.

4.4 Confirmatory Factor Analysis (CFA)

We conducted the CFA using a 4-factor structure, and the factor loadings are presented in Table 8. The chi-square presented statistical significance (χ^2=384, df=147, p<.001). As the chi-square statistic is very sensitive to sample size, it is important to consider other fit indices for a more comprehensive evaluation. For that, we used the Comparative Fit Index (CFI) and Tucker-Lewis Index (TLI), and the results indicated that the four-factor model of the translated version provided an adequate fit to the data (CFI=.956 and TLI=.938), both surpassing the reference value of .90, suggesting an acceptable model fit. We also used the Standardized Root Mean Square Residual (SRMR), which provided a value of .054, below the recommended threshold of .080, indicating

Table 6. Factor loadings of the EFA (oblimin rotation).

Item	Int./Enj.	P. Comp.	P. Choice	Pre./Ten.
IE1	.71			
IE5	.81			
IE8	.85			
IE10	.96			
IE14	.86			
IE19	.87			
PC4		.73		
PC7		.89		
PC12		.79		
PC16		.68		
PC21		.71		
PCH3		.32	.37	
PCH11			.84	
PCH15	.33	.43		
PCH18			.58	
PCH20			.80	
PT2				.54
PT6				.71
PT9	-.59			
PT13				.62
PT17			-.37	.58

Table 7. Correlation matrix between IMI-Teq Br factors.

Factor	IE	PC	PCH	PT
Interest/Enjoyment (IE)	1.00			
Perceived Competence (PC)	.68	1.00		
Perceived Choice (PCH)	.43	.30	1.00	
Pressure/Tension	-.26	-.11	-.18	1.00

an acceptable fit. Cronbach's α coefficient (.867) and McDonald's ω coefficient (.904) indicated consistent item correlations within the scale, suggesting that it is reliable for measuring the targeted construct. Therefore, despite the significant χ^2 value, the fit indices CFI, TLI, and SRMR suggest that the model demonstrates an acceptable fit to the observed data.

Despite the achieved fit indices falling within an acceptable range, it is evident that certain items exhibited weak loadings, such as item PCH18 (λ=.26), PT2 (λ=.38), PT13 (λ=.19), and PT17 (λ=.27). Notably, during the model adjustment process, we observed high residual covariance between item PT9 and the items in interest/enjoyment, as well as between item PCH15 and the items in perceived competence, and among the items of perceived choice in general. These findings strongly suggest that the current 21-item model can be enhanced by removing items from perceived choice and item PT9, resulting in a shorter version of IMI-Teq Br within an even more reliable model. Further research is being conducted to validate and refine a shortened version of the IMI-Teq Br, based on that evidence. Still, the CFA and the model-fit measures show that the 21-item IMI-Teq Br has evidence of validity and suitability for the intended research context. The 21-item version of IMI-Teq Br is detailed in the section 5 in Table 9.

Also, the CFA performed separately on games and digital products showed no significant difference compared to the joint version, only minimal differences in factor loadings.

Hence, up to this research publication, there is no evidence that games and general-purpose applications should be evaluated differently using IMI-Teq.

Table 8. Factor loadings of the CFA.

Item	I/E	P. Comp.	P. Choice	P/T	Z	p
IE1	.87				19.19	.001
IE5	.90				20.40	.001
IE8	.93				21.50	.001
IE10	.96				22.80	.001
IE14	.80				16.91	.001
IE19	.91				20.64	.001
PC4		.77			14.99	.001
PC7		.73			14.73	.001
PC12		.86			17.65	.001
PC16		.79			16.33	.001
PC21		.95			21.27	.001
PCH3			.77		15.26	.001
PCH11			.53		9.57	.001
PCH15			.94		20.74	.001
PCH18			.26		4.55	.001
PCH20			.63		11.29	.001
PT2				.38	6.70	.001
PT6				.52	9.48	.001
PT9				.97	18.91	.001
PT13				.19	3.37	.001
PT17				.27	4.63	.001

5 IMI-Teq Br

Table 9 compares the source version of IMI-Teq (left) and its translated version IMI-Teq Br (right). The translated version presents a **blank space,** named ”Tarefa X” (in English, ”Task X”) that should be replaced with an expression starting with an infinitive verb describing the task under evaluation. For example, if the evaluation is concerned with assessing the player’s motivation during a battle against an enemy in a game, the first sentence of IMI-Teq Br would be: ”Ao **lutar contra o inimigo**, eu pensava no quanto havia gostado de fazer isso.” This sentence would translate to: ”As I fought the enemy, I thought about how much I had enjoyed doing this.” A 7-item Likert scale and use instructions [2] should be included when presenting the scale to respondents.

6 Scoring IMI-Teq Br

The scoring of IMI-Teq Br follows the same procedure as the IMI-Teq. Each item should be scored on a 7-point Likert scale. The items indicated with (R) should be reversed (decreasing 8 of the marked score). Then, an average of the items of each subscale should be taken. It is important to pay attention to the number assignment of the items in each subscale. Table 10 presents the division of items by subscale. A higher score on pressure/tension means the person felt more pressured and tense; a higher score on perceived competence means the person felt more competent; and so on.

7 Discussion

We produced a translation and cultural adaptation of the Intrinsic Motivation Inventory Task Evaluation Questionnaire (IMI-Teq), with the results showing good indications of understanding and validity. We highlight some major insights gathered during our process, described in the following sections.

7.1 Specificities in the translation and adaptation of IMI-Teq Br

The translation and cultural adaptation of a questionnaire into another language version is not a trivial task. Cultural and linguistic differences between the respective populations who speak each language have to be considered during translation [Hunt *et al*., 1991]. In our process, the presence of different profiles during the translation stages of the methodology was crucial to ensure different points of view, such as from the fields of linguistics and psychology, about terms and expressions used and their application depending on the context and target audience.

This importance could be noticed, for example, in one of the discussions during the expert committee, about item 10: ”I enjoyed doing the task very much.” The word *enjoyment* does not have a direct translation in Brazilian Portuguese and can take on different meanings related to *pleasurable, fun* or *satisfying*. So, initially, the Brazilian Portuguese translators used the word *”gostei”* (which can be translated as *”liked”*) instead of the word enjoyed in item 10 during the initial translation of IMI-Teq Br. During the expert committee discussions, the English-speaking translators, who also have knowledge of Brazilian Portuguese, pointed out that the word *”gostei”* had a much weaker meaning than the word *”enjoyed,”* so after testing the use of other words like ”*diverti*” (had fun) or ”*prazeroso*” (pleasurable), the word ”*curtir*” was chosen.

The verb *”curtir,”* in the sense that was used in the translation of IMI-Teq Br, is an informal word defined by a regular dictionary that follows the Common Orthographic Vocabulary of the Portuguese Language as being ”To feel pleasure or satisfaction from; to like a lot” [3]. The other participants pointed out that this word would have an informal meaning from the perspective of native Brazilian Portuguese speakers. Still, since the informal language would not affect the objective of the questionnaire to present a user-friendly language, and that the meaning was closer to the original term for English-speaking participants, it was decided to maintain the term.

Another item affected by the expert committee discussion was item 7 ”I think I did pretty well at this activity, compared to other students.” The use of the term *”students”* was

[2] **Instruções em Português** Para cada uma das afirmações a seguir, indique o quanto ela é verdadeira para você, usando a escala de 7 pontos a seguir, onde: 1 significa de modo algum; 4 significa um pouco verdadeiro; e 7 significa totalmente verdadeiro.

[3] In Portuguese: [...] 8. Sentir prazer ou satisfação por; gostar muito de, in Dicionário Priberam da Língua Portuguesa [online], 2008-2022, https://dicionario.priberam.org/curtir [accessed in 06-07-2022].

Table 9. The source version IMI-Teq and its translated version, IMI-Teq Br

Item	IMI-Teq	IMI-Teq Br
Q1	While I was working on the task, I was thinking about how much I enjoyed it.	Ao **Tarefa X**, eu pensava no quanto havia gostado de fazer isso.
Q2	I did not feel at all nervous about doing the task.	Não me senti nervoso de forma alguma em **Tarefa X.**
Q3	I felt that it was my choice to do the task.	Senti que era minha escolha **Tarefa X.**
Q4	I think I am pretty good at this task.	Acho que sou bom em **Tarefa X.**
Q5	I found the task very interesting.	Achei muito interessante **Tarefa X.**
Q6	I felt tense while doing the task.	Eu me senti tenso ao **Tarefa X.**
Q7	I think I did pretty well at this activity, compared to other students.	Em comparação a outras pessoas, acho que me saí bem em **Tarefa X.**
Q8	Doing the task was fun.	**Tarefa X** foi divertido.
Q9	I felt relaxed while doing the task.	Eu me senti relaxado ao **Tarefa X.**
Q10	I enjoyed doing the task very much.	Curti muito **Tarefa X.**
Q11	I didn't really have a choice about doing the task.	Eu realmente não tive escolha quanto a **Tarefa X.**
Q12	I am satisfied with my performance at this task.	Estou satisfeito com meu desempenho ao **Tarefa X.**
Q13	I was anxious while doing the task.	Eu estava ansioso ao **Tarefa X.**
Q14	I thought the task was very boring.	Achei muito chato **Tarefa X.**
Q15	I felt like I was doing what I wanted to do while I was working on the task.	Ao **Tarefa X**, senti que estava fazendo o que eu queria.
Q16	I felt pretty skilled at this task.	Eu me senti muito habilidoso ao **Tarefa X.**
Q17	I felt pressured while doing the task.	Eu me senti pressionado ao **Tarefa X.**
Q18	I felt like I had to do the task.	Senti que tinha que **Tarefa X.**
Q19	I would describe the task as very enjoyable.	Eu descreveria **Tarefa X** como muito agradável.
Q20	I did the task because I had no choice.	**Tarefa X** foi uma coisa que fiz porque não tive escolha.
Q21	After working at this task for awhile, I felt pretty competent.	Depois de **Tarefa X** por um tempo, me senti muito competente.

Table 10. IMI-Teq Br items by subscale.

Subscale	Items
Interest/Enjoyment	1, 5, 8, 10, 14(R), 19
Perceived Competence	4, 7, 12, 16, 21
Perceived Choice	3, 11(R), 15, 18(R), 20(R)
Pressure/Tension	2(R), 6, 9(R), 13, 17

pointed out by the HCI specialist translator as a limiting term in the sentence, since the use of IMI-Teq Br might not necessarily evaluate students, but a general audience. Then, a discussion was initiated to replace this word in order to represent other audiences. The term *"demais"* was chosen, resulting in the sentence *"Em comparação aos demais, acho que me sai bem nessa atividade"* (which can be translated as *"Compared to the others, I think I did well in this activity."*) During the comprehension test of the pre-final version it was pointed out by the participants that the term *"demais"* was ambiguous, not making it clear to whom the item was referring. Therefore, the expert committee adjusted the term to *"outras pessoas,"* resulting in the sentence "Em comparação a outras pessoas, acho que me saí bem em Tarefa X." (which can be translated as "Compared to other people, I think I did well in Task X").

The method by which the translation process is carried out can have a great effect on its result and, consequently, on its understanding. In this sense, we realize the need for a rigorous process of discussion at the expert committee, making sure that it is formed by multidisciplinary professionals who can ensure reliability and maintain the quality of the questionnaire to be translated [Beaton *et al*., 2002; Nora *et al*., 2018].

7.2 Investigating intrinsic motivation with IMI-Teq Br

Motivation is a decisive factor for well-being [Cerasoli *et al*., 2014], being a fundamental component in any model of human performance. Intrinsic motivation enhances behaviors that favor personal growth, such as seeking challenges and pursuing interests. As a natural motivational force, its rise and fall occur as external variables support or interfere with the individual's self-determination experiences [Reeve *et al*., 2003].

To enable an investigation of the factors that may inhibit or promote intrinsic motivation, even if these are subjective, it is necessary to use validated methods. An intrinsic motivation measurement questionnaire such as IMI-Teq Br can provide support in the assessment of: the impact of new technologies in the classroom [Carrera *et al*., 2018], player's motivation in specific game tasks such as creating avatars [Alankus and Kelleher, 2012] or in the activity of playing a game [Birk *et al*., 2016], and even in activities outside technology, like in the evaluation of students' motivation to learn in academic disciplines [Monteiro *et al*., 2015] or individual's motivation in sports competitions and camps [Fonseca and de Paula Brito, 2001; McAuley *et al*., 1989; Tsitskari and Kouli, 2010].

There is a growing recognition within the HCI field of the importance of designing technologies that promote long-term well-being by fostering eudaimonic experiences [Stephanidis *et al*., 2019]. This shift is driven by advancements in user experience research, particularly in emotional

and pleasure-oriented aspects, as well as by the principles of positive psychology [Gable and Haidt, 2005], which advocate for the promotion of positive human development. However, a notable challenge lies in the practical implementation of these principles within interaction technologies, particularly in merging positive psychology with HCI. Consequently, there is a pressing need in HCI to adopt a more actionable approach that integrates aspects of eudaimonia into the user experience, a concept referred to as user eudaimonia. Nevertheless, a significant hurdle in this convergence of disciplines is measuring these concepts, as human eudaimonia is inherently subjective.

In this context, the translation and validation of IMI-Teq into Brazilian Portuguese (IMI-Teq Br) can significantly contribute to bridging this gap between psychological theories and HCI practice. IMI-Teq Br offers a robust instrument for assessing intrinsic motivation, a key component of eudaimonic well-being, within Brazilian Portuguese-speaking populations [Alankus and Kelleher, 2012; Birk *et al*., 2016; Carrera *et al*., 2018]. By leveraging the principles of Self-Determination Theory (SDT), IMI-Teq Br provides a comprehensive framework for understanding how motivational processes contribute to psychological growth, engagement, and well-being [Ryan and Deci, 2017]. This tool can thus serve as a valuable resource for HCI researchers and practitioners seeking to design and evaluate interactive systems that promote users' long-term well-being and fulfillment.

7.3 Research Limitations

Despite the positive results of the statistical validation, this study presents some limitations that should be acknowledged. Firstly, the CFA yielded successful outcomes; however, it also revealed a significant correlation among the factors in the current model, resulting in weaker loadings for certain items. This finding indicates the potential for model enhancement by eliminating items within Perceived Choice and Pressure/Tension scales. Removing scales or selecting specific items based on research objectives is commonplace when employing the IMI Ryan and Deci [2006]. Developing a shorter version of IMI-Teq Br holds the promise of generating an even more reliable questionnaire, characterized by improved fit indices.

Furthermore, it is important to acknowledge a potential limitation in our study concerning the representativeness of the data gathered during the statistical validation process, stemming from the uneven distribution of samples across the national territory. While the variations adhere to the established Portuguese norm, the presence of underrepresented groups might lead to slightly distorted outcomes. These limitations indicate the importance of future research addressing these concerns and enhancing the overall robustness of IMI-Teq Br as an instrument for evaluating intrinsic motivation.

8 A Brief Manifesto For Building a Healthier Digital Future in Brazil

Evaluating user experience (UX) and player experience (PX) in digital interactive technologies is crucial for understanding user interaction and acceptance. This evaluation extends beyond technical quality, aiming to design positive, engaging, and immersive experiences. However, assessing experience is complex, requiring a deeper investigation into various human subjective characteristics.

To prioritize user well-being, the Self-Determination Theory (SDT) offers a shift from mere engagement to promoting healthy and satisfying experiences, thus reducing the risk of abusive design practices leading to addictive behaviors. SDT also guides the development of psychometric instruments to investigate UX and PX qualities. Yet, there's a need to translate and validate these instruments across different cultural contexts, including the Brazilian research community, to ensure effectiveness and applicability.

Considering users' intrinsic motivation and self-determination when designing and evaluating interactive technology is crucial to avoid abusive and unethical design practices, particularly in addressing the engagement-addiction dilemma. To address this challenge effectively, it's imperative to develop theoretical and practical foundations that comprehensively consider the impacts of interactive technologies on human well-being, integrating perspectives from Psychology, Ethics, and Design. Failure to address this challenge risks perpetuating harmful design practices that exploit users' autonomy and focus solely on hedonic aspects while neglecting eudaimonic well-being. Therefore, a concerted effort is needed to deepen research efforts in this direction, addressing both hedonic and eudaimonic aspects of well-being.

Translating and adapting IMI-Teq to the Brazilian context is one step towards this goal, but intrinsic motivation is not the only construct of interest. In addition to IMI-Teq, other instruments are available for assessing SDT constructs in digital interactions. One such tool is the Player Experience of Needs Satisfaction (PENS) questionnaire, designed to measure the satisfaction of basic psychological needs during video game play [Rigby and Ryan, 2007]. Another instrument, the Basic Needs in Games Scale (BANGS), is designed to measure the satisfaction and frustration of basic psychological needs during video game play [Ballou *et al*., 2023]. The Emotion Regulation Inventory (ERI) assesses various styles of emotion regulation, providing insights into psychological well-being and adaptive functioning [Roth *et al*., 2009]. The Self-Regulation Questionnaires (SRQ) cover various domains and seek to understand behaviors and motivations [Loevinger, 1957; Grolnick and Ryan, 1989; Ryan and Deci, 2000].These instruments are just part of the catalog of tools proposed over time that work on SDT concepts and they offer valuable insights into the factors influencing individuals' motivation and behavior in specific contexts[4]. Their translation and cross-cultural adaptation into Brazilian Portuguese holds significant promise for advancing research and practice in understanding human behavior and wellbeing in Portuguese-speaking communities. By making these instruments accessible to researchers and practitioners, we can facilitate cross-cultural comparisons, inform interventions, and promote psychological health and wellbeing in diverse cultural contexts, thus increasing the community's active role in shifting the

[4]https://selfdeterminationtheory.org/questionnaires/

focus of HCI and game evaluations to a perspective where well-being is placed as the main focus.

Moreover, there is a need for developing more instruments and techniques that consider our own cultural and social contexts, extending beyond the translation and cultural adaptation of existing psychometric tools. By addressing cultural and contextual nuances, these instruments can provide researchers and practitioners with valuable insights into user experiences, ultimately leading to the development of more effective and culturally relevant interactive technologies.

But we can go beyond psychometrics. HCI design and evaluation methods should be reformulated to include eudaimonic well-being as an essential part is imperative, particularly considering the specificities of cultural, regional, political, and social issues in the Brazilian context. Adopting data collection and analysis methods that incorporate eudaimonic experience into their conceptual framework is vital, taking into account the diverse cultural backgrounds and social norms prevalent in Brazil. Strategies must be developed to prevent mental health consequences and interpersonal relationship interferences caused by interactive technologies, considering the socioeconomic disparities and cultural diversity present in the country.

Establishing metrics and methodologies to incrementally evaluate the impact of digital technologies on users' eudaimonic and hedonic well-being over time is paramount, especially in a country with vast social inequalities and cultural variations across different regions. Conducting and publishing case studies that foster a culture of formative evaluation of the impact of technology in human well-being, considering effects beyond hedonic aspects is necessary. Experimental studies analyzing physical, psychological, and social factors of eudaimonic well-being with interactive systems should be conducted, taking into consideration the unique societal challenges and cultural nuances prevalent in Brazil.

Furthermore, promoting transparency and replication of research on well-being in HCI by making artifacts used or produced in research readily available is essential for advancing the field, ensuring that findings can be contextualized and applied effectively within the Brazilian context. The Brazilian community has the potential to contribute significantly to this endeavor, fostering the development of a healthier way to develop and evaluate interactive technology, tailored to our unique cultural landscape, thereby enriching the understanding of UX and PX in diverse contexts.

9 Conclusion

The lack of translated and validated psychometric HCI instruments in Portuguese for use in the Community of Portuguese Language Countries (CPLP) motivated this study, which aimed to produce the translation and adaptation into Brazilian Portuguese of the Intrinsic Motivation Inventory, specifically its 22-item version Task Evaluation Questionnaire (IMI-Teq), designed to explore intrinsic motivation in general tasks. Through rigorous translation and validation processes, we have addressed this gap, providing a reliable tool for researchers and practitioners in the CPLP region. This work not only ensures the validity and reliability of research outcomes but also contributes to advancing our understanding of motivation in HCI and game user research, thereby laying the groundwork for future interdisciplinary collaborations and applications.

We validated the translation using statistical tests, including T-test for independent samples, exploratory factor analysis (EFA), and confirmatory factor analysis (CFA). The T-test results indicated that IMI-Teq Br effectively differentiates between motivating and demotivating experiences, with higher scores in the Interest/Enjoyment, Perceived Competence, and Perceived Choice subscales for motivating experiences, and higher scores in the Pressure/Tension subscale for demotivating experiences. The factor analysis results demonstrated the adequacy of the IMI-Teq Br 21-item model in terms of validity and reliability (one item was removed due to cultural and linguistic adaptation). However, the findings also suggest the potential for further improving the current model by reducing the number of items.

IMI-Teq Br represents a significant contribution with far-reaching implications for both the HCI and Games User Research (GUR) communities in Brazil and other Portuguese-speaking countries. This adaptation not only enhances data accuracy and reliability for researchers in these communities but also provides deeper insights into user experiences, thereby enriching the theoretical and practical aspects of HCI and GUR studies. Consequently, it informs game design processes and strategies to improve user experiences across various interactive systems.

Moreover, IMI-Teq Br promotes interdisciplinary collaboration among HCI, psychology, and game studies, facilitating the integration of psychological theories into both research and practice. Beyond its immediate application in these fields, the translated instrument holds potential utility in diverse domains such as education [Monteiro *et al*., 2015] and sports [McAuley *et al*., 1989; Tsitskari and Kouli, 2010].

Looking ahead, our future endeavors aim to introduce a condensed version of IMI-Teq Br, refining the model to achieve better-fit indices. Furthermore, extending the application of IMI-Teq Br to diverse contexts and audiences will validate its suitability across varied scenarios. Through these endeavors, we aspire to contribute to a collective comprehension of the social and technical determinants shaping users' motivation within HCI and games user research.

Declarations

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Authors Contribution: CN and TD contributed to the conception of this study, analysis, and writing. CN is the main contributor and

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Competing interests

The authors declare that they have no competing interests.

Availability of data and materials

Aiming to maintain the anonymity of participants, the data collected cannot be shared.

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