# Measuring Motivations of Crowdworkers: The Multidimensional Crowdworker Motivation Scale

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#### Abstract

Crowd employment is a new form of short term and flexible employment which has emerged during the past decade. For understanding this new form of employment, it is crucial to understand the underlying motivations of the workforce involved in it. This paper presents the Multidimensional Crowdworker Motivation Scale (MCMS), a scale for measuring the motivation of crowdworkers on micro-task platforms. The scale is theoretically grounded in Self-Determination Theory and tailored specifically to the context of crowdsourced micro-labor. The MCMS was validated on data collected in ten countries and three income groups. Furthermore, measurement invariance tests showed that motivations measured with the MCMS are comparable across countries and income groups. This work constitutes a first step towards understanding the motivations of the international crowd workforce.

Keywords: crowdworkers, motivation, self-determination theory, scale, validation, invariance

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### 1. Introduction

During the past decade, crowd employment has emerged as a new form of short term and flexible employment. Crowd employment has been defined as a type of employment which "uses an online platform to enable organisations or individuals to access an indefinite and unknown group of other organisations or individuals to solve specific problems or to provide specific services or products in exchange for payment" [40]. While this definition is similar to the concept of crowdsourcing [35], it explicitly includes only those activities that are performed in exchange for payment.

One type of crowd employment platforms are micro-task platforms such as Amazon Mechanical Turk<sup>1</sup> (AMT) or CrowdFlower<sup>2</sup>. On micro-task platforms, crowdworkers are payed on a per-task basis and a single task usually pays only a few cents upon completion. The micro-tasks offered to workers on these platforms are also called "human intelligence tasks" and typically require workers to solve problems that are easy to solve for humans, but hard to solve for computers. This characteristic led Amazon Mechanical Turk to coin the term "artificial artificial intelligence" for describing this type of work. Typical micro-tasks include classification and tagging of text or images, audio and image transcription, and validating addresses of companies on the Web. Also more complex tasks such as editing text documents [3], ontology alignment [53] and the evaluation of unsupervised machine learning algorithms (e.g. [6, 22, 47]) have been successfully deployed on micro-task platforms. Anyone, regardless of geographical location or education, can perform micro-tasks – the only necessary requirement is having access to the Internet.

The emergence of crowd employment and a general trend towards more flexible and shorter term employment has given rise to policy discussions on social protection and working conditions of crowdworkers (e.g. [46, 11, 10, 21]). One ongoing discussion is whether crowd employment is to be considered "work"

<sup>&</sup>lt;sup>1</sup>http://www.mturk.com/

<sup>&</sup>lt;sup>2</sup>http://www.crowdflower.com/

at all, or whether it is mostly considered a spare-time activity by many workers, meaning that payment plays only a minor role for them [46]. Currently, on popular micro-task platforms, the achievable hourly wage is below 2 US\$ (e.g. [49, 32, 38]). While this amount is above minimum wage in some countries, in many high-income countries it is far below the wage of any traditional job. Despite this, the rise of crowd employment is an international phenomenon which does not exclude high-income countries. Understanding the underlying motivations of the "indefinite and unknown group" of crowdworkers is therefore crucial in understanding this new form of employment.

This paper develops the groundwork for understanding the motivations of the international crowd workforce by presenting the Multidimensional Crowdworker Motivation Scale (MCMS). The MCMS is theoretically grounded in Self-Determination Theory (SDT) and tailored specifically to the context of crowd-sourced micro-labor. Most items in the MCMS are based on items from existing SDT-based motivation scales (such as the Multidimensional Work Motivation Scale [26] and the Work Extrinsic Intrinsic Motivation Scale [56]), which were adapted to the idiosyncrasies of work on micro-task platforms.

The main contributions of this paper are (1) an evaluation of two existing SDT-based work motivation scales with respect to their suitability for microtask crowdwork, (2) the development of the Multidimensional Crowdworker Motivation Scale (MCMS), (3) a validation of the MCMS in ten countries and three income groups, and (4) an evaluation of the cross-country and cross-group comparability of motivations measured with the MCMS. To the best of our knowledge, this is the first SDT-based work motivation scale for the crowdworking domain which is validated in multiple countries and groups.

This paper is structured in the following way: Section 2 gives a short overview of the different types of motivation as conceptualized by Self-Determination Theory and reviews existing SDT-based work motivation scales. Furthermore, it gives an overview of related work on the motivations of crowdworkers on micro-task platforms. In Section 3 we evaluate the suitability of existing SDT-based work motivation scales for the crowdworking domain and show the

need for a work motivation scale adapted to the idiosyncrasies of this domain. Section 4 describes the process of developing the MCMS and Section 5 presents a validation of the MCMS in ten countries and three income groups. In Section 6, we demonstrate the cross-country and cross-income group comparability of motivations measured with the MCMS. Finally, Section 7 concludes this work and discusses the scale's limitations as well as directions for future research.

#### 2. Related Work

Self-Determination Theory and Work Motivation. Self-Determination Theory (SDT) was developed by Deci and Ryan [15, 16, 17]. The theory specifies three general kinds of motivation, amotivation, extrinsic motivation and intrinsic motivation, which lie along a continuum of self-determination. At the one extreme of the continuum lies amotivation which completely lacks self-determination; at the other extreme lies intrinsic motivation which is completely self-determined [24]. Between these extremes lies extrinsic motivation, which is further split up into subtypes with varying degrees of internalisation: external regulation, introjected regulation, identified regulation and integrated regulation.

While SDT hypothesizes that the different types of motivation fall along a continuum structure, empirical evidence for this continuum hypothesis is inconsistent (e.g. [7, 34]). There is evidence that motivations differ more in *kind* than in *degree* and that SDT-based motivation scales are best represented by multidimensional models [7]. Howard and Gagné [34] found evidence for a continuum structure, but they also highlight the importance of taking into account the quality of motivation.

Figure 1 (adopted from [24]) shows the types of motivation as specified by SDT. Amotivation is the absence of motivation, a state of acting passively or not intending to act all. External regulation is the least self-determined form of extrinsic motivation. Individuals motivated by external regulation act in order to obtain rewards or avoid punishments [18]. Introjected regulation refers to a form of partially internalized extrinsic motivation which aims at the avoidance



Figure 1: **Types of motivation.** This figure shows the different types of motivation along the self-determination continuum hypothesized by SDT. The figure was adopted from Gagné and Deci [24].

of guilt or at attaining feelings of worth [18]. *Identified regulation* is a form of extrinsic motivation with a high degree of perceived autonomy, where the action is in alignment with the individual's personal goals. *Integrated regulation* is the most self-determined form of extrinsic motivation and stems from evaluated identifications that are in alignment with self-endorsed values, goals and needs [18]. The most self-determined form of motivation is *intrinsic motivation*. This form of motivation is non-instrumental and people act freely, driven by interest and enjoyment inherent in the action [52].

Several work motivation scales have been developed based on SDT. The first SDT-based work motivation scale was a French scale developed by Blais et al. [4]. Tremblay et al. [56] translated this scale into English and conducted an evaluation in different work environments. The resulting Work Extrinsic and Intrinsic Motivation Scale (WEIMS) measures six factors: amotivation, the four external regulation subtypes and intrinsic motivation. Gagné et al. [25] created the Motivation at Work Scale (MAWS), a scale which measures the four factors external regulation, introjected regulation, identified regulation and intrinsic motivation. The MAWS was validated in French and in English and was partly based on [4].

Later, Gagné et al. [26] developed the Multidimensional Work Motivation Scale (MWMS). The MWMS was validated in seven languages and nine countries and does not include any items from the MAWS. MWMS measures six first-order factors (amotivation, material external regulation, social external regulation, introjected regulation, identified regulation and intrinsic motivation) and one second-order factor (external regulation).

Work motivation scales such as MWMS, MAWS and WEIMS investigate motivations at the domain level of analysis, meaning that they measure the general motivation to perform a job as opposed to specific tasks within a job. Besides the domain of work, SDT-based scales for measuring motivation also exist for many other domains such as sports [20, 44], teaching [19] or academics [58].

Crowdworker Motivation on Micro-Task Platforms. Most research investigating the motivations of workers on micro-task platforms has focused on the platform Amazon Mechanical Turk (AMT). Consequently, most studies have focused on American and Indian crowdworkers, which constitute the vast majority of workers on AMT [36, 49]. This country distribution is likely due to the fact that workers can receive money from AMT in the USA and in India while workers from other countries are paid in Amazon.com gift cards [57].

One early study on the reasons crowdworkers have for participating on AMT was conducted by Ipeirotis [36]. He asked the multiple choice question "Why do you complete tasks in Mechanical Turk?", offering six response possibilities. The study found that more Indians than Americans treat AMT as a primary source of income, and that few Indian workers report the reason "To kill time." Hossain [33] created a classification of motivation in online platform participation, listing extrinsic and intrinsic motivators and incentives.

Kaufmann et al. [37] developed an early model for measuring crowdworker motivations on AMT, differentiating between enjoyment based motivation, community based motivation, immediate payoffs, delayed payoffs and social motivation. They used a sample composed of Indian and US workers on AMT and found that the construct with the highest score was "immediate payoffs," i.e. payment. Their study further found that the pastime score correlated positively with household income and negatively with the weekly time spent on AMT, and that workers who spend a lot of time on AMT may be motivated very differently

than workers who spend little time on the platform.

Antin and Shaw [1] used a list experiment for investigating social desirability effects in motivation self-reports of crowdworkers from the USA and India on AMT. Using the four items "to kill time," "to make extra money," "for fun" and "because it gives me a sense of purpose," they found that US workers tend to over-report all four reasons while Indian workers tend to over-report "sense of purpose" and under-report "killing time" and "fun."

For measuring extrinsic motivations of crowdworkers, Naderi et al. [42] evaluated a 4-factor model using a subset of WEIMS items on a sample of US workers on AMT. In this model, identified and integrated regulation are merged into one factor, and the intrinsic motivation factor is omitted.

Several qualitative studies on the motivations of crowdworkers have been conducted. For example, Gupta et al. [28, 29] investigated, among other aspects, the motivations of Indian crowdworkers on AMT and Martin et al. [41] studied the content of a forum for AMT users. Other research related to the motivations of crowdworkers includes measuring the impact of motivation on performance [48] and manipulating motivations via task framing [5] or achievement feedback [39].

### 3. Suitability of Existing Work Motivation Scales

In order to determine whether existing SDT-based work motivation scales are suitable for application in the crowdworking domain, we conduct an evaluation of the WEIMS and the MWMS with crowdworkers on CrowdFlower. The reason for choosing CrowdFlower over AMT is that we aim to develop a motivation scale suitable for an international comparison of crowdworker motivations, instead of exclusively focusing on crowdworkers in the USA and in India. We consider CrowdFlower to be better suited for this task as it pays workers via independent partner channels<sup>3</sup> and therefore attracts a more international crowd-workforce.

<sup>&</sup>lt;sup>3</sup>http://www.crowdflower.com/labor-channels/

In order for the scale stems and items to be conceptually applicable to the crowdworking domain, minimal adaptations had to be performed. For WEIMS, we changed the stem "Why do you do your work?" to "Why do you do Crowd-Flower tasks?" and replaced the word "it" (referring to "your work") in the items with "CrowdFlower tasks." The stem of MWMS "Why do you or would you put efforts into your current job?" was changed to "Why do you or would you put efforts into CrowdFlower tasks?" and words in the items referring to "your current job" were replaced with "CrowdFlower tasks." Additionally, one item in the MWMS was conceptually not applicable to the domain and had to be minimally adapted. There is no concept of "losing one's job" on micro-task platforms. The closest concept on CrowdFlower is failing many quality control questions, which results in a lower worker account accuracy and consequently in less tasks being offered to the worker. Therefore, the item "Because I risk losing my job if I don't put enough effort in it." was changed to "Because I risk not being offered enough tasks if I don't put enough effort into them.".

We choose to use the term "CrowdFlower tasks" in the stems and items instead of a more general term because workers who are logged into CrowdFlower via the partner channels see that they are doing "CrowdFlower tasks." We can therefore assume that workers know what CrowdFlower tasks are. In contrast, general terms like "micro-tasks" or "human intelligence tasks" are widely used in scientific publications and sometimes in the media but we cannot be sure that workers on CrowdFlower understand this term as it does not appear frequently on channel websites or on the platform itself.

For both of the minimally adapted work motivation scales, we collected 500 responses from crowdworkers residing in the USA. Anonymity was ensured. After removing spammers (also see Section 5), the sample size was 424 for the WEIMS and 414 for the MWMS. This constitutes a subject to item ratio higher than 20:1 which is a suitable ratio for factor analysis [45, 23].

Confirmatory Factor Analysis. We use confirmatory factor analysis (CFA) for evaluating the factor structure of the models. For all confirmatory factor analyses, we used the R packages lavaan [50] and semtools [54]. As the

item distributions were skewed, we used a robust maximum likelihood estimator (as suggested in e.g. [14]). By specifying a robust maximum likelihood estimator, the model parameters were estimated with robust standard errors and a Satorra-Bentler (S-B) scaled test statistic is reported [50].

We evaluated the model fit based on the absolute fit measures root mean squared error of approximation (RMSEA) and standardised root mean square residual (SRMR) as well as the incremental fit measures comparative fit index (CFI) and Tucker-Lewis index (TLI). For cut-off values of the goodness-of-fit measures, we followed the recommendations in Hooper et al. [30]: A well fitting model should have an RMSEA of less than 0.08, a SRMR of less than 0.05, and ideally a CFI and TLI higher than 0.95 (but at least 0.9). Furthermore, we report the (S-B scaled) Chi-Square test statistic but do not rely on it for determining model fit as it is very sensitive to sample size (e.g. [2]).

Models. We test the following models for the adapted WEIMS: (1) The original WEIMS model with 6 factors (WEIMS-M1), (2) an alternative 5 factor WEIMS model with the factors identified regulation and integrated regulation loading onto a single factor (WEIMS-M2), and (3) the 4 factor, 12 item subset of WEIMS items which was used by Naderi et al. [42] to measure the extrinsic motivations of workers on Amazon Mechanical Turk (WEIMS-M3). The rationale for evaluating the alternative model WEIMS-M2 is that the integrated regulation factor has been shown to be poorly separable from identified regulation and

Table 1: Evaluation of existing work motivation scales. This table shows the goodness-of-fit measures for the different models based on existing SDT-based work motivation scales which were minimally adapted to the crowdworking domain.

Scale/Model	N	$\mathrm{S-B}\chi^2$	df	CFI	TLI	RMSEA	RMSEA 90% CI	SRMR
WEIMS-M2	424	500.58	125	0.908	0.888	0.084	0.077 0.091	0.067
WEIMS-M3	424	191.13	80	0.962	0.950	0.057	0.048 0.067	0.044
MWMS-M1	414	828.27	143	0.818	0.782	0.108	0.101 0.114	0.170
MWMS-M3	414	667.90	139	0.859	0.827	0.096	0.089 0.103	0.155
MWMS-M4	414	532.55	137	0.895	0.869	0.084	0.077 0.091	0.087

intrinsic motivation (e.g. [56, 58]), which is also one of the reasons for why the MWMS does not include an integrated regulation factor [26].

For the MWMS, we test the model originally hypothesized by Gagné et al. [26] (MWMS-M1) and the model which had the best fit in [26] (MWMS-M2). Furthermore, we test a 6 factor model where material external and social regulation are separate factors, omitting the second-order external regulation factor. This model is tested with a hypothesized correlation of zero between intrinsic motivation and both external regulation factors (MWMS-M3) and without the correlation restriction (MWMS-M4).

**Evaluation Results.** None of the evaluated models, with the exception of the 4-factor model WEIMS-M3, which does not measure intrinsic motivation, had an acceptable model fit on our data. Table 1 shows the goodness-of-fit statistics of the different models.

The WEIMS model with 6 factors (WEIMS-M1) could not be estimated due to the factors identified regulation and integrated regulation not being distinguishable from another, which resulted in the covariance matrix of the factors not being positive definite. This is consistent with the findings of Naderi et al. [42]. Also for the alternative 5 factor model WEIMS-M2, the goodness-of-fit measures were not in the acceptable range.

The 4 factor model WEIMS-M3 was the only evaluated model with a good fit. However, besides the drawback that the model does not measure intrinsic motivations, it has additional limitations: It includes one item for measuring the amotivation construct which was criticized by Gagné et al. [26] for resembling low satisfaction of the need for competence rather than measuring amotivation ("I ask myself this question, I don't seem to be able to manage the important tasks related to this work."). Furthermore, two of the four factors (external regulation and introjected regulation) are measured by only two items each and external regulation had a low reliability (Crohnbach's alpha of 0.63) in our evaluation. Note, however, that this evaluated subset of WEIMS is not completely identical to the one used by Naderi et al. [42] due to the small adaptations made in item phrasing.

Of the evaluated MWMS models, the 6-factor model with separate factors for social external and material external regulation and no correlation restrictions had the best fit. However, the fit was not acceptable, with all goodness-of-fit measures being outside acceptable ranges. The fit measures for MWMS-M2 are not included in Table 1 due to the covariance matrix of the factors not being positive definite.

Our results show that the evaluated work motivation scales developed for the traditional work context do not work well within the crowdworking context when only minimal adaptations in item phrasing are made. For the development of a reliable motivation scale which measures the motivations of crowdworkers on all dimensions, further adaptations are needed.

#### 4. Development of the MCMS

The results of the confirmatory factor analysis conducted on the slightly modified WEIMS and MWMS show the necessity for developing a new scale for measuring the motivations of crowdworkers that is adapted to the idiosyncracies of the crowdwork environment. To meet this necessity, we developed the Multidimensional Crowdworker Motivation Scale (MCMS) in three steps. First, we compiled a pool of items conceptually suitable for the characteristics of the crowdworking domain. Most of the items in the pool were adapted from existing SDT-based motivation scales. Second, we selected items from the pool based on exploratory factor analysis on a sample of workers residing in the USA. Third, we further reduced the item pool based on exploratory factor analyses on samples from Spanish<sup>4</sup> and Indian crowdworkers.

For generating the item pool, we first conducted exploratory factor analysis on the data collected with WEIMS and MWMS in order to identify which items of these scales should be included in the MCMS development item pool. For all exploratory factor analyses, we use oblique rotation (promax), because

<sup>&</sup>lt;sup>4</sup>In this paper, we use country demonyms synonymously with the location of workers for better readability.

in line with SDT we expect the latent factors to be correlated. WEIMS and MWMS items that had very low loadings on the appropriate factor as well as items that had high crossloadings were not included in the pool. Furthermore, we added only those items from WEIMS to the pool which were not deemed problematic by MWMS, i.e. we excluded items that were culturally sensitive or that addressed needs rather than motivations. We included all items from the MWMS which were conceptually suitable for the crowdworking domain. The minimal adaptions to the crowdworking domain described in the previous section were kept.

To extend the pool, we added semantically suitable items from the motivation scales developed in [20] and [19] as well as several new items. The total number of items in the pool was 44. The stem phrasing "Why do you or would you put efforts into doing CrowdFlower tasks?" adapted from MWMS was used in order to capture both actual and latent motivations.

For a first selection of items from the pool, we collected answers from 1,000 crowdworkers residing in the USA. Exploratory factor analysis was conducted on the responses. Consistent with the findings from Section 3, we found that material external regulation and social external regulation did not load on the same factor. Therefore, we aimed at a 6-factor model with the two separate external regulation factors (social and material). Items which had very low factor loadings on the appropriate factor (< 0.5), items which loaded on a factor different to the one theorized as well as items with high cross-loadings (> 0.35) were iteratively removed from the initial pool, creating a reduced item pool with 36 items.

We conducted a second round of data collection with this reduced item pool, collecting responses from 1,000 Spanish and 1,200 Indian crowdworkers. The additional 200 responses from the Indian crowdworkers were requested due to the high amount of spam in this response set (also see Section 5), with the aim of achieving an item-to-response ratio of close to 1:20. Again, we iteratively removed items with low loadings (with the higher threshold of < 0.7 if more than three items were left for this construct), wrong loadings, or high cross-

loadings (with the threshold of > 0.3). Furthermore, if two items were phrased very similarly and the factor had more than three items remaining, we removed the item with the lower loading.

The final MCMS contains 18 items, with three items loading on each factor. Of the 18 final items, five were adapted from [26], four from [56], two from [19] and [44] each, and five items are new (but semantically based on items from existing scales). Like other SDT-based work motivation scales, the MCMS aims to measure motivations at the domain level of analysis (i.e. the job) as opposed to specific tasks within a job. Table A.10 shows the scale.

#### 5. Validation of the MCMS

Data Collection. With the final version of the MCMS, we collected data from 10 countries, with 900 participants from each country for validation. We selected countries from three World Bank income groups<sup>5</sup>: high income, upper middle income and lower middle income. From each of the three income groups, we selected three countries with high activity on CrowdFlower. The countries were selected according to the following criteria: The country had to be active on CrowdFlower (either high in the Alexa<sup>6</sup> ranking or one of the top contributing countries in at least one of the partner channels) and we aimed for a high cultural diversity overall as well as within the income groups. For the high income group, the selected countries were USA, Germany and Spain. The upper middle income group contains Brazil, Russia and Mexico, and the lower middle income group is comprised of India, Indonesia and the Philippines. Note that in the rest of this paper, we use the group label "Middle Income" (MID) for the upper middle income group and "Low Income" (LOW) for the lower middle income group for better readability.

In addition, we collected responses from Venezuela as it was the most active country on CrowdFlower at the time of data collection, with CrowdFlower

 $<sup>^5</sup> http://databank.worldbank.org/data/download/site-content/CLASS.xls \\$ 

<sup>&</sup>lt;sup>6</sup>http://www.alexa.com/

receiving 18.5% of traffic from this country<sup>7</sup>. However, we did not include Venezuela in the data grouped by income as we believe it represents a special case: At the time of data collection the US\$ earned on CrowdFlower could be sold on the black market at a rate several orders of magnitude higher than the official exchange rate [43].

In order to capture a diverse sample of crowdworkers in each country, the starting times of the survey were divided into three groups: (1) 300 responses were requested during typical working hours (8:00 am to 5:00 pm in the appropriate time zone), (2) 300 responses were requested in the evening (6:00 pm to 11:pm in the appropriate time zone) and finally, (3) 300 responses were requested during weekends. The data was collected in October and November 2016.

Table 2: Sample sizes and percentage of spam received. This table shows the sample sizes of the different groups before and after spam removal, as well as the percentage of spam received.

Group	Code	$\mathbf{N}_{raw}$	spam	$\mathbf{N}_{clean}$
All	ALL	9000	35 %	5857
High Income	HIGH	2700	28 %	1952
Middle Income	MID	2700	32~%	1835
Low Income	LOW	2700	44~%	1508
USA	USA	900	20 %	722
Spain	ESP	900	25~%	677
Germany	DEU	900	35~%	554
Brazil	BRA	900	45~%	496
Russia	RUS	900	25~%	677
Mexico	MEX	900	26~%	662
India	IND	900	32~%	608
Indonesia	IDN	900	55~%	401
Philippines	$\operatorname{PHL}$	900	45~%	499
Venezuela	VEN	900	37~%	563

<sup>&</sup>lt;sup>7</sup>Data obtained from http://www.alexa.com/.

The items in the MCMS were randomly permuted and presented to crowd-workers as a task on CrowdFlower. Besides the MCMS items, the task also included a section with demographic questions and questions about money use, as well as a section where workers were instructed to think of five reasons for why they do tasks on CrowdFlower and asked to write down these reasons. Anonymity was ensured.

**Spam Detection.** We expected a significant amount of spam in the responses, such as people not reading the questions and clicking randomly or workers accepting the task despite having insufficient English skills. To counteract a high amount of noise in the dataset, we included three test items in the motivation scale section of the CrowdFlower task, and an additional test question in the demographics section.

The test items in the motivation scale section of the task asked participants to answer with a specific ranking on the Likert scale and the test question in the demographics section consisted of the question "Are you paying attention to the questions?" with the possible answers "No," "Yes" and "I don't know" selectable from a drop-down list. These questions ensure that less than 0.1%  $((\frac{1}{7})^3 * \frac{1}{3})$  of spammers pass the test questions. Table 2 shows the percentage of spam and the sample size after spam removal in each country and income group. The table also introduces the country and group codes used in the remainder of this paper.

**Hypothesized Model.** Due to the results of the evaluation of existing scales and the results from exploratory factor analysis on the MCMS item pool, we model material external and social external regulation as two separate factors. Hence, our hypothesized model is a 6-factor model where all factors are first-order factors. Note that the material and social external regulation are not adjacent factors in the continuum hypothesized by SDT but occupy the same spot.

While SDT hypothesizes that intrinsic motivation does not correlate with external regulation [26, 51], Chemolli and Gagné [7] found that intrinsic motivation correlates with external regulation significantly for both the MWMS

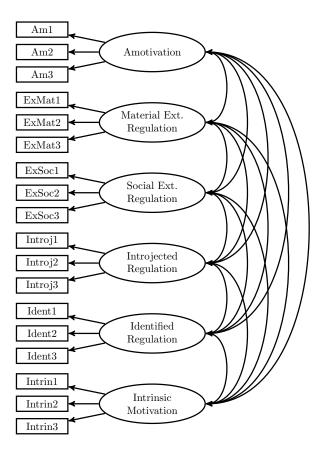


Figure 2: Factor structure of the MCMS. This figure shows the factor structure of the hypothesized MCMS model.

and the Academic Motivation Scale [58]. Due to these findings, we decided not to restrict these correlations to zero in our hypothesized model, but we evaluate the model fit of both the correlation-restricted and the unrestricted model. No cross-loadings were hypothesized. The hypothesized model is depicted in Figure 2.

Descriptive Statistics and Internal Consistency. Table 3 summarizes the empirical factor means as well as standard deviations for each of the countries and income groups in our data. Table 4 displays the Pearson correlations of the empirical factor means. The observed correlations do not strictly follow the

continuum hypothesized by SDT (i.e. adjacent factors correlate stronger than nonadjacent factors). However, we do observe a negative correlation between intrinsic motivation and amotivation, and the strongest correlations are between adjacent factors (intrinsic motivation with identified regulation and introjected regulation with social external regulation).

Table 3: **Empirical means and standard deviations.** This table shows the empirical means and standard deviations for all groups and factors.

Group	Amotivation	Material	Social	Introjected	Identified	Intrinsic
ALL	1.84 (1.09)	6.05 (1.08)	2.47 (1.58)	2.25 (1.46)	4.27 (1.73)	5.67 (1.26)
HIGH	2.06 (1.21)	5.86 (1.18)	1.99 (1.37)	1.91 (1.29)	3.56 (1.73)	5.27 (1.37)
MID	1.86(1.06)	6.12 (1.02)	2.68(1.60)	2.59(1.58)	$4.53\ (1.65)$	5.82 (1.18)
LOW	1.72 (1.02)	6.13 (0.99)	2.74 (1.68)	2.31 (1.44)	4.60 (1.57)	5.90 (1.11)
USA	1.91 (1.17)	5.86 (1.25)	1.67 (1.19)	1.58 (1.12)	3.38 (1.74)	5.28 (1.43)
ESP	2.10(1.20)	5.96 (1.07)	2.46 (1.48)	2.34(1.45)	3.89 (1.71)	5.37 (1.33)
DEU	$2.23\ (1.26)$	5.72(1.21)	1.82(1.31)	1.83(1.15)	3.4(1.67)	5.15 (1.35)
BRA	1.89(0.97)	$6.28\ (0.87)$	2.59(1.6)	2.38(1.48)	4.62(1.71)	5.98 (1.1)
RUS	1.95(1.1)	5.93 (1.15)	2.67(1.67)	2.83(1.68)	4.48 (1.61)	5.6 (1.28)
MEX	1.75(1.09)	$6.18\ (0.95)$	2.76(1.53)	$2.51\ (1.52)$	4.51(1.65)	5.92 (1.10)
IND	$1.71\ (1.02)$	6.17 (1.02)	2.54(1.67)	2.33(1.49)	4.56(1.62)	5.92 (1.12)
IDN	1.99(1.16)	$6.12\ (0.88)$	3.06(1.70)	2.65(1.43)	4.62(1.4)	5.86 (1.11)
PHL	$1.53\ (0.84)$	6.09 (1.05)	2.71(1.63)	2.00(1.30)	4.63(1.63)	5.92 (1.09)
VEN	$1.31\ (0.62)$	6.27(0.98)	2.76(1.56)	2.14(1.43)	4.97(1.66)	5.97 (1.09)

Table 4: **Empirical correlations between factors.** This table shows the empirical Pearson correlations between the six factors of the MCMS, calculated on the total sample.  $^{***}p < 0.001$ .

	Amotivation	Material	Social	Introjected	Identified
Material	$-0.21^{***}$				
Social	0.02	$0.12^{***}$			
Introjected	0.13***	0.08***	$0.52^{***}$		
Identified	$-0.18^{***}$	0.35***	0.43***	0.39***	
Intrinsic	$-0.43^{***}$	0.31***	0.28***	0.20***	$0.46^{***}$

Cronbach's alpha statistic [12] was used to assess the internal consistency of the MCMS. Table 5 displays the values of alpha for each country and income group. As a rule of thumb, values above 0.7 are considered acceptable, values between 0.6 and 0.7 questionable, values between 0.5 and 0.6 poor and values below 0.5 unacceptable [27]. In most countries and groups, alpha exceeds 0.7 for each construct. Exceptions to this are the amotivation factor in Brazil and Venezuela as well as the material external regulation factor in Brazil and Indonesia with values between 0.5 and 0.7. Therefore, when interpreting results from these factors and groups, care should be taken.

Confirmatory Factor Analysis. In order to validate the factor structure of our hypothesized model, we conducted confirmatory factor analysis. The first

Table 5: Internal consistency of the MCMS. This table shows Cronbach's alpha values for all groups and constructs, along with a 95% confidence interval for the values.

Group	Amotivation	Material	Social	Introjected	Identified	Intrinsic
ALL	$0.78$ $(0.77 \ 0.79)$	$0.78$ $(0.77 \ 0.79)$	$0.84$ $(0.83 \ 0.84)$	$0.83$ $(0.82 \ 0.84)$	$0.87$ $(0.86 \ 0.88)$	0.88 (0.88 0.89)
HIGH	0.84 (0.82 0.85)	0.82 (0.8 0.83)	0.85 (0.84 0.86)	0.86 (0.85 0.87)	0.87 (0.86 0.88)	0.9 (0.89 0.91)
MID	$0.7$ $(0.68 \ 0.73)$	$\underset{\left(0.73\ 0.77\right)}{0.75}$	$\underset{(0.81\ 0.84)}{0.82}$	$0.83$ $(0.82 \ 0.84)$	$\underset{(0.85\ 0.87)}{0.86}$	$\underset{(0.86\ 0.88)}{0.87}$
LOW	$\underset{(0.76\ 0.8)}{0.78}$	$0.77$ $(0.75 \ 0.79)$	$\underset{(0.84\ 0.87)}{0.85}$	$0.8$ $(0.78 \ 0.82)$	$0.85$ $(0.83 \ 0.86)$	$\underset{(0.86\ 0.88)}{0.87}$
USA	0.86 (0.84 0.87)	0.84 (0.82 0.86)		0.83 (0.81 0.85)	0.85 (0.84 0.87)	0.9 (0.89 0.91)
ESP	$0.83$ $(0.81 \ 0.86)$	$0.8$ $(0.78 \ 0.83)$	$0.85$ $(0.83 \ 0.87)$	$0.87$ $(0.86 \ 0.89)$	$\underset{(0.88\ 0.91)}{0.89}$	$0.9$ $(0.89 \ 0.92)$
DEU	$\underset{(0.8\ 0.85)}{0.82}$	$0.8$ $(0.78 \ 0.83)$	$\underset{(0.86\ 0.89)}{0.87}$	$0.82$ $(0.79 \ 0.85)$	$0.85$ $(0.82 \ 0.87)$	$0.86$ $(0.84 \ 0.88)$
BRA	$0.52$ $(0.45 \ 0.59)$		$0.83$ $(0.8 \ 0.85)$		$0.89$ $(0.87 \ 0.9)$	$0.86$ $(0.84 \ 0.88)$
RUS	$\underset{(0.74\ 0.8)}{0.77}$		$0.88$ $(0.87 \ 0.9)$	$\underset{(0.86 0.9)}{0.88}$	$0.85$ $(0.83 \ 0.87)$	
MEX	$\underset{(0.76\ 0.82)}{0.79}$	$\underset{(0.68\ 0.75)}{0.72}$	$\underset{(0.74\ 0.8)}{0.77}$	$0.78$ $(0.75 \ 0.81)$	$0.85$ $(0.83 \ 0.87)$	$\underset{(0.84\ 0.88)}{0.86}$
IND	$\underset{(0.7\ 0.78)}{0.74}$	$0.82$ $(0.79 \ 0.84)$	$\underset{(0.85\ 0.88)}{0.87}$	$0.79$ $(0.76 \ 0.82)$	$0.85$ $(0.83 \ 0.87)$	$0.87$ $(0.86 \ 0.89)$
IDN	$\underset{(0.75\ 0.82)}{0.79}$	$\underset{(0.59\ 0.71)}{0.65}$	$\underset{(0.83\ 0.88)}{0.85}$	$0.79$ $(0.75 \ 0.82)$	$0.79$ $(0.75 \ 0.82)$	$\underset{(0.82\ 0.87)}{0.84}$
PHL	$0.8$ $(0.77 \ 0.83)$	$0.8$ $(0.77 \ 0.83)$	$0.84$ $(0.81 \ 0.86)$	$0.82$ $(0.79 \ 0.84)$	$0.88$ $(0.86 \ 0.9)$	0.88 $(0.87 0.9)$
VEN	$0.6$ $(0.55 \ 0.66)$	$0.77$ $(0.74 \ 0.8)$	$\underset{(0.73\ 0.8)}{0.76}$	$0.77$ $(0.73 \ 0.8)$	$\underset{(0.84\ 0.88)}{0.86}$	

item of each factor in Table A.10 serves as the marker variable (i.e., the loading of this item is fixed to one).

Table 6 shows the results of the confirmatory factor analysis of the hypothesized model. The analysis was conducted on the entire dataset as well as on each group separately. As in Section 3, we follow the guidelines of Hooper et al. [30] for evaluating model fit. The results show that the hypothesized model has adequate fit overall as well as in all groups. The CFI was above 0.95 in all groups except Indonesia and Mexico (with 0.931 and 0.948, respectively). RMSEA was lower than 0.06 in all groups and SRMR was lower than or equal to 0.05 in all groups. We consider the fit measures for Mexico and Indonesia to be borderline acceptable, but some care should be taken when interpreting the results from these countries.

Table 7 shows the item loadings and intercepts estimated by the hypothesized

Table 6: Confirmatory Factor Analysis of the MCMS. This table shows the goodness-of-fit statistics for the hypothesized MCMS model. The fit statistics are given for the total sample as well as for all groups.

Group	N	$\mathrm{S} ext{-}\mathrm{B}\chi^2$	df	CFI	TLI	RMSEA	RMSEA 90% CI	SRMR
ALL	5857	1590.49	120	0.965	0.955	0.046	0.044 0.048	0.037
HIGH	1952	573.64	120	0.970	0.961	0.044	0.041 0.047	0.037
MID	1834	557.07	120	0.964	0.955	0.045	0.041 0.048	0.038
LOW	1508	554.52	120	0.955	0.942	0.049	0.045 0.053	0.036
USA	721	281.45	120	0.965	0.956	0.043	0.037 0.049	0.040
ESP	677	272.66	120	0.975	0.968	0.043	0.037 0.050	0.040
DEU	554	284.42	120	0.955	0.943	0.050	0.043 0.056	0.044
BRA	496	256.58	120	0.957	0.946	0.048	0.040 0.055	0.044
RUS	677	311.67	120	0.966	0.957	0.049	0.043 0.055	0.039
MEX	661	316.27	120	0.948	0.933	0.050	0.043 0.056	0.048
IND	608	272.66	120	0.962	0.951	0.046	0.039 0.052	0.042
IDN	401	272.08	120	0.931	0.912	0.056	0.049 0.064	0.050
PHL	499	291.47	120	0.954	0.941	0.054	0.046 0.061	0.045
VEN	563	217.07	120	0.966	0.956	0.038	0.031 0.045	0.039

model and Table 8 shows the estimated correlations between the constructs. All estimated factor correlations are statistically significant at p < 0.01 (most at p < 0.001).

The alternative model which restricts the correlations of the external regulation factors (material external regulation and social external regulation) with intrinsic motivation to zero did not have an acceptable fit: While CFI was close to 0.95 for most groups (0.948 for the total sample), SRMR was high for the total sample (0.094) as well as for all other groups, ranging between 0.074 in the USA and 0.113 in Russia.

### 6. Cross-Group Comparability of MCMS Results

When comparing the results of a measurement instrument across different groups, a key is to ensure that the instrument possesses the same psychometric properties in all groups. This characteristic is referred to as measurement

Table 7: **Estimated loadings and intercepts.** This table shows the item loadings ( $\lambda$ ) and intercepts ( $\tau$ ) estimated by the hypothesized model. The first item of each construct is the marker item, with its loading fixed at 1. The order of the items follows the order in Table A.10.

	Amoti	vation	Mat	erial	ial Social		Introjected		Identified		Intrinsic	
	λ	$\tau$	λ	$\tau$	$\lambda$	$\tau$	λ	$\tau$	λ	$\tau$	$\lambda$	τ
item 1	1	1.824	1	5.987	1	2.285	1	2.251	1	4.274	1	5.623
item 2	0.882	1.683	0.708	6.101	0.844	2.041	1.001	2.309	1.098	3.967	0.88	5.758
item 3	0.955	2.012	0.946	6.059	0.937	3.086	1.08	2.186	1.014	4.56	0.995	5.637

Table 8: Estimated correlations between constructs. This table shows the model estimates of the correlations between constructs. \*\*p < 0.01, \*\*\*p < 0.001.

	Amotivation	Material	Social	Introjected	Identified
Material	$-0.263^{***}$				
Social	$0.051^{**}$	$0.128^{***}$			
Introjected	0.151***	$0.108^{***}$	$0.600^{***}$		
Identified	$-0.222^{***}$	0.440***	0.458***	$0.449^{***}$	
Intrinsic	$-0.523^{***}$	$0.362^{***}$	0.283***	$0.230^{***}$	$0.525^{***}$

invariance. Tests of measurement invariance evaluate "whether or not, under different conditions of observing and studying phenomena, measurement operations yield measures of the same attribute" [31]. In our case, measurement invariance means that crowdworkers from different countries (or country income groups) assign the same meaning to the items used in the MCMS.

For evaluating measurement invariance of the MCMS, we conduct Multigroup Confirmatory Factor Analysis (MGCFA). In MGCFA, measurement invariance is evaluated via a series of hypothesis tests which test invariance at different levels. Three levels of measurement invariance are required for comparing latent mean differences across groups: configural, metric and scalar invariance (e.g. [9, 8]). Configural invariance requires that the items share the same configurations of loadings in all groups. Metric invariance requires that the loadings of each item on its factor is the same across groups. Scalar invariance requires that the intercepts of item regressions on the factor are the same across groups.

We calculate configural, metric and scalar invariance of the MCMS for countries and income groups. Table 9 displays the results of the MGCFA. Configural

Table 9: **Measurement invariance.** This table shows the results of the MGCFA tests of invariance between groups and countries. The deltas are with respect to the previous level of measurement invariance, i.e. for scalar invariance, the sum of the deltas for metric and scalar invariance should be below 0.01 for CFI and below 0.015 for RMSEA. \* 1 free intercept (Am3), \*\* 5 free intercepts (Am3, ExMat2, ExSoc3, Introj2 and Ident2).

	CFI	CFI $\Delta$	RMSEA	RMSEA $\Delta$
Income Groups				
Configural Invariance	0.964	n/a	0.046	n/a
Metric Invariance	0.963	0.001	0.045	0.001
Full Scalar Invariance	0.952	0.011	0.049	0.005
Partial Scalar Invariance*	0.955	0.008	0.048	0.004
Countries				
Configural Invariance	0.96	n/a	0.047	n/a
Metric Invariance	0.959	0.001	0.046	0.001
Full Scalar Invariance	0.930	0.028	0.058	0.011
Partial Scalar Invariance**	0.952	0.007	0.049	0.002

invariance is indicated by acceptable goodness-of-fit indices in an MGCFA model without any equality constraints [59]. For indications of metric and scalar non-invariance, we follow the guidelines of Chen [8]: For metric and scalar invariance in large samples (N>300), a change of  $\geq -0.010$  in CFI supplemented by a change of  $\geq 0.015$  in RMSEA indicates non-invariance.

Table 9 shows the goodness-of-fit indices for the progressively restricted models. The results show a good fit for the model without equality constraints, indicating that configural invariance is supported. Full metric invariance was also achieved, indicating that the strength of the relationship between the items and constructs is the same across groups. Full scalar invariance could not be achieved. However, partial scalar invariance was achieved by releasing one intercept for the income groups (Am3) and five intercepts in the countries (Am3, ExMat2, ExSoc3, Introj2 and Ident2). Achieving partial scalar invariance allows for factor means to be compared. However, Steinmetz' [55] simulations showed that unequal intercepts may lead to wrong conclusions when comparing observed composite means across groups. Therefore, as only partial and not full scalar invariance was achieved for the MCMS, a comparison of the scale's latent factor means should rely on the model-implied means instead of observed composite means.

### 7. Conclusion

In this paper, we presented the Multidimensional Crowdworker Motivation Scale (MCMS), a new scale for measuring crowdworker motivations. The scale measures the motivations of crowdworkers on six dimensions, based on the conceptualization of motivation suggested by Self-Determination Theory (SDT). To the best of our knowledge, the MCMS is the first instrument for measuring motivation in the context of crowdsourced micro-labor which is validated in multiple countries and income groups. Furthermore, the results of the measurement invariance analyses show that motivations measured with the MCMS are comparable across countries and income groups. This work constitutes a first step

towards understanding the motivations of crowdworkers in an internationally comparable way.

The work presented in this paper has several limitations. First of all, the scale was presented in English to the crowdworkers in all countries, which means that we are only able to capture the motivations of crowdworkers with appropriate English skills.

Regarding the presence of social desirability bias, Blais et al. [4] found that self-reported work motivations only correlated very weakly with the Marlow-Crowne Social Desirability Scale [13] (correlations between -0.18 and 0.20). However, as Antin and Shaw [1] found evidence for the presence of social desirability bias in self-reported motivations of crowdworkers, further experiments are needed in order to assess the extent to which social desirability bias is present in data collected with the MCMS.

A further limitation of the MCMS is that it does not measure integrated regulation. The lack of an integrated regulation factor in the MCMS is due to problems of statistically distinguishing this factor from identified regulation and intrinsic motivation. Due to the same problems, this limitation is also present in other work motivation scales such as the MWMS [26].

Another limitation of this work is that the extent to which motivations measured with the MCMS are related to different antecedents and outcomes has not been assessed yet. For investigating the relations between measured motivations and antecedents (e.g. the satisfaction of basic needs) or outcomes (e.g. emotional exhaustion), the scales for measuring the antecedents and outcomes would first have to be validated within the crowdworking domain.

In future work, we plan to conduct a cross-country as well as a cross-income group comparison of crowdworker motivations using the model-implied means. Furthermore, we plan to investigate the relationship between motivations and other demographic factors. Another direction which we plan to follow in future work is the development of Bayesian models which incorporate not only the responses to the MCMS items but also responses to open-ended survey questions and demographic metadata. This work is relevant for researchers and

practitioners interested in measuring the motivations of crowdworkers.

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## Appendix A. The Multidimensional Crowdworker Motivation Scale

Table A.10: **The Multidimensional Crowdworker Motivation Scale.** The stem is "Why do you or would you put efforts into doing CrowdFlower tasks?". All items were answered on a 7-point Likert scale ranging from "not at all" (1) to "completely" (7). The column "Source" indicates from which motivation scale the item was adapted.

		Source
Amotivat	ion	
Am1	$I\ don't\ know\ why,\ CrowdFlower\ tasks\ often\ seem\ like\ a\ waste\ of\ time.$	
Am2	I don't know why I'm doing CrowdFlower tasks, it's pointless work.	[26]
Am3	$I\ don't\ know\ why,\ I\ often\ perceive\ CrowdFlower\ tasks\ as\ an\ annoying\ chore.$	[19]
${\bf External}$	Regulation (Material)	
ExMat1	Because CrowdFlower tasks give me financial gains.	
ExMat2	For the income CrowdFlower tasks provide me.	[56]
${\bf ExMat3}$	Because of the money I get from doing CrowdFlower tasks.	
External	Regulation (Social)	
ExSoc1	Because other people want me to do CrowdFlower tasks (e.g. family, friends,).	
$\operatorname{ExSoc2}$	Because other people say I should (e.g. family, friends,).	[44]
ExSoc3	Because other people expect it of me (e.g. family, friends,).	
Introjecte	ed Regulation	
Introj1	Because otherwise $I$ would have a bad conscience.	[19]
Introj2	Because otherwise I will feel ashamed of myself.	[26]
Introj3	Because otherwise I will feel bad about myself.	[26]
Identified	Regulation	
Ident1	Because this is the type of work $I$ chose to do to attain a certain lifestyle.	[56]
Ident2	Because I chose this type of work to attain my career goals.	[56]
Ident3	Because it is the type of work I have chosen to attain certain important objectives.	[56]
Intrinsic	Motivation	
Intrin1	Because I have fun doing CrowdFlower tasks.	[26]
Intrin2	Because I enjoy doing CrowdFlower tasks.	[44]
Intrin3	Because what I do in CrowdFlower tasks is interesting.	[26]