Interest as a Moderator in the Relationship between Challenge/Skills Balance and Flow at Work: An Analysis at Within-Individual Level

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Financial support to CB given by the PsicoSAO Research Group (2014SGR992) is acknowledged. Financial support to JN given by the Spanish Government (Ministerio de Economía y Competitividad, project number PSI2013-44854-R) is also acknowledged.

This paper has been accepted to be published in Journal of Happiness Studies

Abstract

Considering flow as a non-ergodic process (i.e., non-homogeneous across individuals and non-stationary over time) that happens at the within-individual level, in this research we work with Bakker's model that propose flow as made up by three components: intrinsic motivation, enjoyment, and absorption. Taking into account that flow theory can be considered as an intrinsic motivation theory, and the recent proposals about the need to distinguish between pre-conditions of flow and the flow experience itself, we look at interest as a moderator between the challenge/skills balance and the experience of flow, rather than a component of the flow experience. A total of 3640 recordings were collected from a sample of 58 workers using an experience sampling method (several registers a day, during 21 working days). The data was analyzed using regression techniques in each participant (i.e., at within-individual level). Our work tries to respond to the following two research questions: Will interest play a moderating role in the relationship between challenge/skills balance and flow? Will a non-linear model (cusp catastrophe model) better explain the relationship among challenge/skills balance, interest, and flow? The results suggest that our hypotheses were correct: including interest as moderator better explains the relationship between challenge/skills balance and flow in comparison to a model without moderation (R^2 values change from 0,33 to 0,50). Additionally, carrying out the analysis following non-linear techniques explained more variance as well (R^2 = 0,67), and this increment was significant. These results support the idea that interest should be considered as a key precondition for the appearance of flow, and this relationship is non-linear. We could say that these findings are exemplary in the field and brings up questions for their application in further research.

Key words: flow, challenge/skills balance, interest, non-ergodic process, non-linear modelling.

Flow can be considered a positive, rewarding experience, which cultivates positive emotions such as excitement, joy, happiness, and pride (Ceja and Navarro in press). Flow is known to be correlated with better performance (e.g., Demerouti 2006) because it is a highly functional state, enticing individuals to immerse themselves in an activity, and "individuals experiencing flow are more motivated to carry out further (learning) activities" in order to experience flow again (Engeser and Rheinberg 2008, p. 160). An individual cannot experience the same intensity of flow with the exact same activity more than once, and after every episode of flow, individuals are slightly different from who they were before, as they have increased their skill level regarding a specific task (Ceja and Navarro 2012, in press).

The dynamic nature of flow as well as the different ways to measure flow in recent decades has aroused our interest in this topic, specifically in understanding whether interest should be considered as a necessary pre-condition for the appearance of flow, instead of as an indicator of flow at work, as it is considered in most research up to date. In our opinion this is important because flow theory is considered a theory of intrinsic motivation (e.g. Csikszentmihalyi, Abuhamdeh, and Nakamura 2005) and, in this sense, the decision of including interest as an indicator of flow experience can be considered as a tautology. We will develop this argument further later.

To achieve our aim we will structure this introduction as follows: first, we will define key terms used in this research (flow, challenge/skills balance, and interest); second, we will expose two popular ways of defining flow in work and organizational psychology literature – proposed by Csikszentmihalyi and Bakker; third, we will explore the possible relations between interest and flow experience; fourth, we will consider flow as a non-ergodic process, in line with the previous works of Molenaar and Campbell (2009) and Ceja and Navarro (in press); and lastly, we will introduce the research question and hypotheses that guided this study.

Defining Key Terms: Flow, Challenge/Skills Balance, and Interest

In 1975, the pioneer of flow research, Mihaly Csikszentmihalyi, published his book *Beyond Boredom and Anxiety* where he presented the concept of *flow*. This concept was the result of an extensive study carried out on artists, chess players, and other creative professionals, looking at activities that they found inherently motivating. In order to accurately define flow, professionals from various occupations were asked to recognize the flow experience in a set of definitions, based on their own personal experiences. Since its initial formulation, the definition of flow has been modified to fit the advances of flow research. Although researchers today generally agree on the definition of flow, there are still certain disagreements among authors as to how it should be measured (see Delle Fave, Massimini and Bassi 2011; Moneta 2012). This growing paradox has posed many challenges to those researching flow; both in the modelling of the flow experience and in the choice of method to measure and define flow. Despite the disagreement on how to measure it, flow can be defined as “a state in which people are so involved in an activity that nothing else seems to matter; the experience itself is so enjoyable that people will do it even at a great cost, for the sheer sake of doing it’’ (Csikszentmihalyi 1990, p. 4). Much of the literature on flow up until now uses a comparable definition to the one stated above as the basis for delving deeper into the topic. Definitions of flow also include key concepts such as: challenge/skills balance, motivational orientation (intrinsic versus extrinsic motivation), activity specifications (clarity of goals or clear feedback about the progress made), etc. (see Abuhamdeh 2012; Bassi and Delle Fave 2012; Engeser and Rheinberg 2008; Jackson and Ecklund 2002).

In order to understand the evolution of the conceptualization and modelling of flow, it is important to grasp the concept from its roots. The observations from Csikszentmihalyi’s

(1975) aforementioned research, gave way to the first model of the flow state, known as the channel model. This first model characterizes flow as a balance between a person's challenge and skills level. It posits that when the challenge at hand is met by the necessary skills, flow takes place. This exists where both challenge and skills are low, medium, or high. This model also includes examples of where flow will not take place, namely the anxiety and boredom areas, where the ratio of challenges to skills is imbalanced. For example, an activity will produce anxiety when the challenge is high and the skills necessary to overcome such a challenge are low. On the opposite side of the spectrum, individuals can experience boredom if their skills are higher than the ones necessary to deal with the challenges they face.

The experience of flow, or flow channel (i.e. when challenge meets skills) was initially called the optimal experience. Csikszentmihalyi called flow this way because "flow is defined as a psychological state in which the person feels simultaneously cognitively efficient, motivated, and happy" (Moneta and Csikszentmihalyi 1996, p. 277). Hence, optimal activities are characterized by high cognitive investment and affected by affective, motivational, and volitional variables (Bassi and Delle Fave 2012).

Since its appearance in 1975, the original flow model has been criticized for being too simple. As a result, it was abandoned in favour of the eight-channel model. This new model further emphasized the two conditions that must be satisfied in order to experience flow: (1) a balance between challenge and skills, and (2) both challenge and skills must be higher than average (Moneta 2012).

At this point, it is important to define the terms *challenge* and *skills* in order to better understand what theory means by the balance between challenge and skills. A *challenge* is a demanding situation where a person has a high opportunity for action and growth. This means that the situation is perceived by the individuals as challenging, in terms of their perceived skills, and therefore believe that they can use their skills to overcome this situation. At this point it is important not to confuse challenge with a difficulty; a difficulty is a barrier people have to overcome in order to achieve their goal, whereas working towards overcoming a challenge implies the possibility for growth. Moreover, in a challenging situation individuals believe they have control over the situation. For example, two students learning the same piece of music will interpret it as a challenge or a difficulty depending on the skills that each of them has. The student who has been playing the instrument for a longer time and is used to deciphering music partitions will see it as a challenge and the one who does not yet master the instrument may consider it as a difficulty.

Skills are the abilities or tools that a person has to cope with the challenge. When both challenges and skills are high, we speak of an optimal challenge. In a state of *balance*, “one feels both optimally challenged and confident that everything is under control” (Engeser and Rheinberg 2008, p. 1).

However, an imbalance between challenge and skills is inevitable, so in workplace if the workers find themselves bored, they could continually address this boredom and transform it into flow by finding new challenges. Similarly, if the challenge is too much for the skills the employees have, they can overcome anxiety by gaining the skills they need to cope with such a challenge (Ceja and Navarro 2012, p. 1104). Therefore, flow is dynamic and developmental and must constantly be re-created in order for the employee to avoid settling in the “equilibrium zone where they tend to repeat work-related activities the same way they have done it in the past” (Ceja and Navarro, in press, p. 2).

The third, and last, key term is *interest*. Some authors have considered interest as an emotion, others as a motivational state. On the one hand Silvia (2008), considers interest as an emotion associated with orientation, activation, concentration and approach-oriented action.

On the other hand, Reeve (2008) describes interest as a motivational state that arises out of attraction to a particular domain or activity. Here interest is related with the need of mastery: something is interesting for us because we need to understand it. We consider that interest can be sparked by a sense of exploration for something new, something uncertain, something curious, something challenging, and so on (Berlyne 1960; Reeve 2008). Moreover, interest can also plays an important role in well-practiced tasks -if individuals are interested in an activity, they will be more likely to repeat this task in the future. For this, we should consider that to experience optimal challenges during the activities that we are doing, we must be interested in them in the first place. In consequence, interest would be considered as a requirement to experience challenge, and consequently flow. We will develop this argument later in the section on Interest and Flow Experience.

Two Main Ways of Conceptualizing and Measuring Flow at Work

In literature regarding flow at work, there exist two distinct leading views on flow, both led by esteemed researchers: Mihaly Csikszentmihalyi and Arnold Bakker. Of course, there are other approaches that can be applied (e.g., Rheinberg, Vollmeyer and Engeser 2008). However, the models of Csikszentmihalyi and Bakker have been predominant to measure flow at work. Csikszentmihalyi, with further research by Jackson and Marsh (1996), suggests that there are nine components that constitute flow; Bakker reduces the complex experience of flow to just three components. Bakker's conceptualization of flow was developed taking into consideration the experience of flow at work, whereas Csikszentmihalyi's is less context-dependent. This difference can be observed in the different ways they use to measure flow; Jackson and Ecklund, who base the Flow State Scale-2 and the Dispositional Flow Scale-2 on Csikszentmihalyi's conceptualization of flow, include factors which occur in work and leisure situations, whereas Bakker, in his WOLF measure, concentrates strictly on work-related tasks.

Given the disparity between the two, it is understandable that the methods used to measure flow are quite different, depending on which theoretical framework is adopted. We will now describe these two approaches in more detail.

Csikszentmihalyi (1975) proposed six components of flow: 1) merging of action and awareness, 2) centring of attention, 3) loss of self-consciousness, 4) sense of control, 5) clear goals and 6) autotelic nature or intrinsic motivation. Further research by Jackson and Marsh (1996) suggested the final nine components of flow by adding: 7) clear, unambiguous feedback, 8) alteration of time (time goes faster or slower than usual while carrying out a specific activity), and finally, and most importantly, 9) a balance between challenges and skills. Csikszentmihalyi (1975) also introduced the first measure of flow, the Flow Questionnaire. More detailed and reliable measurement methods were developed to replace this first questionnaire, still using Csikszentmihalyi's work as a foundation, namely the Flow State Scale-2 and the Dispositional Flow Scale-2 (Jackson and Ecklund 2002; Jackson, Martin, and Eklund, 2008) with different versions (short, core and long). The Flow State Scale-2 is used to measure flow during a specific activity, whilst the Dispositional Flow Scale-2 assesses the general tendency to experience flow (Jackson et al. 2010 p. 12).

These scales have the advantage of providing a comprehensible and complete characterization of flow, which provides measures for each component that are psychometrically more valid and reliable than those obtained with the original Flow Questionnaire (Csikszentmihalyi and Csikszentmihalyi 1988). Meeting the standards required by traditional test theory was the primary motivation for the development of these scales. However, like all measurement methods, we can also observe some limitations. For example, it does not consider the possibility of obtaining a differentiated measure of the antecedents and indicators of flow, an aspect that, some years after, will appear as important to the development of the theory (Fullagar and Kelloway 2013; Nakamura and Csikszentmihalyi 2009).

Aside from Csikszentmihalyi's way of conceptualizing and measuring flow, there exists a second way of conceptualizing flow at work used extensively by flow researchers. Up until now, many authors (e.g., Demerouti 2006; Demerouti, Bakker, Sonnentag and Fullagar 2012; Rodríguez-Carvajal et al. 2010; ten Brummelhuis et al 2011, etc.) have adopted Bakker's conceptualization of flow at work because of its simplicity compared to Csikszentmihalyi's. Focusing on the flow experience itself, Bakker proposes to look at three concepts: absorption, enjoyment, and intrinsic motivation. According to Bakker (2005), absorption refers to the state of total immersion in the activity, where time flies and distractions become invisible. Enjoyment, the second dimension proposed by Bakker, is the "outcome of cognitive and affective evaluations of the flow experience" (Bakker 2005, p. 27). Lastly, intrinsic work motivation "refers to the need to perform a certain work-related activity with the aim of experiencing the inherent pleasure and satisfaction in the activity" (Bakker 2005 p. 28).

The Work Related Flow Inventory (WOLF for short; Bakker 2008) was developed in line with these three dimensions and has proved to be valid for measuring flow in work situations. However, the origin of the three components Bakker proposes is still unclear. According to Bakker himself, these elements are the core components that are shared by the most prominent flow definitions (Bakker 2005). However, he does not report any research to confirm this assertion.

Bakker considers the balance between challenge and skills as an antecedent of flow experience, as other authors such as Csikszentmihalyi, and Jackson and Marsh present in their research on the topic. In the work environment, job demands are synonymous to challenges and should match that person's professional skills in order for flow to occur. Job resources such as autonomy, performance feedback, social support from colleagues and supervisory coaching, are also said to play a key role in facilitating the experience of flow (Bakker 2005). At this point, Bakker is also interested in the knowledge of the preconditions or causes for the appearance of flow, connecting flow with the wider job demands-resources model. Posterior research has found support for this idea where, for example, job and personal resources influence flow experience at work (e.g. Makikangas, Bakker, Aunola and Demerouti 2010; Salanova, Bakker and Llorens 2006).

Interest and Flow Experience

Flow is a fleeting experience, making it difficult to operationalize and measure. Because of the volatile nature of this state, it makes it hard to distinguish between the proximal antecedents and the actual experience of flow (e.g., Rodríguez-Sánchez, Schaufeli, Salanova, Cifre and Sonnenschein 2011). However, there is a growing necessity and trend in recent flow research that suggests that the concept of flow must be divided into antecedents, or pre-conditions, and the actual experience of flow (Nakamura and Csikszentmihalyi 2009), instead of adopting models, like Bakker's three-dimensional approach, which only considers the experience of flow itself. Taking Csikszentmihalyi's nine components as a basis for this partition, Nakamura and Csikszentmihalyi (2009) and Fullagar and Kelloway (2013) suggest the following division: *antecedents* are a high level of task challenge accompanied by a high level of skill, clear specific goals, and clear feedback. The *experience* would be characterized by the six core components of flow such as intense absorption, intrinsic motivation, sense of control, merging of action and awareness, loss of self-consciousness, and transformation of time.

However, controversies about this categorization exist. For example, according to

Rodríguez-Sánchez et al. (2011), intrinsic motivation acts as an antecedent to an optimal experience, rather than it being an actual element of flow. As they say “intrinsic interest should be conceived as a motivational factor that drives a person to engage in a particular intrinsically rewarding activity. By doing so, the likelihood of experiencing flow is increased. However, during the flow experience itself, intrinsic interest is not experienced” (Rodríguez-Sánchez et al. 2011, p. 76). Therefore, in their study of daily flow patterns in work and non-work contexts, Rodríguez-Sánchez et al. decided to measure flow strictly using the emotional and cognitive component of flow: enjoyment and absorption respectively. They based their two-factors operationalization of flow on previous research carried out by authors such as Skadberg and Kimmel (2004) and Ghani and Deshpande (1994), which both consider absorption and enjoyment as the core elements of flow, leaving interest out of the equation.

In this study, we also argue that a flow should be measured only using enjoyment, and absorption, and we take previous research one step further and investigate interest as a moderator. There are different reasons to consider this. First because considering the previous work of Rodríguez-Sánchez et al. we must be in favour of considering interest, at least, as a precondition to the experience of flow and not as a part of the experience itself. However, in our opinion interest would play a special role in comparison with other preconditions of flow. We would expect that, if a person is not intrinsically interested in carrying out an activity it is unlikely that, in such conditions, the person would enter flow. Interest drives people to pay attention to a specific activity, to concentrate on it, and to orientate their behaviour to this activity (e.g., Reeve 2008). After this, people engage in the activity, increasing the likelihood of experiencing flow which would then be measured simply using enjoyment and absorption following Bakker's framework. In fact there is empirical evidence, which posits that a model of two dimensions (enjoyment and absorption) obtains better best-fit indexes in comparison with the original three-dimensions model (Rodríguez-Sánchez, Cifre, Salanova, and Aborg 2008). In consequence interest would not be playing part in the actual experience of flow, but rather as an impulse for a person to carry out an activity that will be highly gratifying. Interest would play the role of a moderator between the preconditions and the experience of flow itself.

Second, interest for an activity in the workplace is essential in fostering flow because it serves as an approach mechanism to the specific task. If people are inherently interested in an activity, they will be more likely to engage in an activity that they will enjoy and this activity will be more likely to be conducive to flow. The initial interest will foster further interest in the activity.

Based on these arguments, that otherwise seem to be very reasonable, we propose that interest should be better considered as another pre-condition of the appearance of flow experience, but not as a component of the experience itself. In addition, it also seems to be that interest can play a special and a different role in comparison to others pre-conditions (e.g. challenge-skills balance). That is, it can play the role of moderator in the sense that the appearance of flow is more probable during activities in which the person feels intrinsically interested.

Summing up, an important assumption that drives this research is that a balance between challenge and skills will lead to the experiencing of flow if the activity is inherently interesting to the individual in question. This means that, because flow theory is considered as a good example of a theory of intrinsic motivation, the rationale that this theory proposes will work only when a person feels intrinsically motivated by the task at hand. For this to be tested, we will introduce interest as a moderator in the relation between balance of challenges and skills and flow (see hypothesis section). We will defend the idea that without interest, whether there is a balance between challenge and skills, an individual will be less likely to experience flow.

There is already evidence that between the balance of challenges and skills and the emergence of flow experience, different variables can intervene. For instance, Engeser and Rheinberg (2008) have found how this relationship was moderated by the importance of the activity and by the achievement motive. Previously, Eisenberger, Jones, Stinglhamber, Shanock, and Randall (2005) found that only in the achievement-oriented employees, high skill and challenge was associated with flow experience. In consequence, current flow theory also needs to clarify under which conditions the balance between challenge and skills (and other pre-conditions such as clear goals and feedback) produces flow.

Flow As an Non-Ergodic and Nonlinear Process

In a popular paper called, *A Manifesto on Psychology as an Idiographic Science: Bringing the Person back into Scientific Psychology, This Time Forever,* Molenaar (2004) highlights the fundamental flaw of research in Psychology up until today: to generalize results obtained at the inter-individuals level to the intra-individual level, and vice versa. These two levels, which fundamental differences are often ignored, cannot be treated as one. The inter-individuals level, also called between-subjects level, is derived by pooling across individuals, where all focus is on the differences between individuals "regardless of whether the data are gathered cross-sectionally, longitudinally, or according to a multilevel design" (Molenaar and Campbell 2009, p. 112). The intra-individual level, also called within-subject, focuses its attention on the temporal dynamics in one or more processes of interest in one or many individuals. Molenaar suggests that it is also possible to make clusters of subjects which have the same temporal patterns in the processes studied.

Molenaar has shown that only for ergodic processes would inter-individual results be generalizable to the intra-individual level, and vice versa. Ergodicity is a statistical characteristic that refers to homogeneity and stationarity (Molenaar and Campbell 2009). Homogeneity dictates that the same statistical pattern should apply to the data of all individuals in the given population. In order to satisfy the stationarity clause, the data must have invariant statistical characteristics over time (Molenaar and Campbell 2009). Only for ergodic processes can the results obtained from one of the levels be applied to the other. However, many psychological phenomena, including, but not limited to developmental, learning, and adaptive processes, do not comply with these two requirements of ergodicity.

In our opinion, flow is an excellent example of a non-ergodic phenomenon in Psychology. It is often measured using experience sampling method, introducing the temporal factor into the equation. By doing so, flow is measured for each individual using a series of variables (e.g., interest, absorption, etc.) on a series of occasions. Ceja and Navarro (in press) have shown that flow is a person-specific process, which is not stable over time (i.e. is not stationary). Flow has been considered as an emergent motivation in the sense that “what happens at any moment is responsive to what happened immediately before” (Nakamura and Csikszentmihalyi 2009, p. 196).

Moreover, flow has been approached as a fleeting experience, which should be approached through non-linear dynamical systems, which would “give us the tools to assess the complexity of each person’s fluctuating behaviour respecting the non-ergodic characteristics of work-related flow” (Ceja and Navarro, in press, p. 10). Ceja and Navarro (2011) have shown that flow follows nonlinear dynamics (i.e. chaotic dynamics) over time. When people master challenges while doing an activity, they develop their skills at the same time. This increment in the level of skills supposes the search of progressively more complex challenges. Then, flow does not fit well with homeostatic equilibrium points (Nakamura and

Csikszentmihalyi 2009). Instead, it presents nonlinear and complex dynamics without apparent equilibrium points.

Looking at flow from the dynamic perspective, it can be considered as a magnetic pole (or attractor), that attracts employees towards it. According to Ceja and Navarro (2012), the sudden transitions between the flow and non-flow state can be modelled using catastrophe theory. This theory explains the sudden, discontinuous changes that occur in the dependent variables as a result of small, continuous changes in the independent variables. The advantages of using this theory is that it is able to model continuous as well as discontinuous changes, the outliers are included in the model (rather than being considered as a measurement error), and we are able to draw accurate conclusions from this model.

Taking these considerations (non-ergodicity and non-linearity of flow experience) into account, flow research should explore this process at the within-level and also consider its non-linearity and complex changes over time. As we show next, we are interested in considering this within-person and nonlinear nature of flow experience in our research design to study the role played by interest in the flow model.

The Present Study: Research Question and Hypotheses

The aim of this research will be to propose that interest should be considered as a moderator for flow experience rather than part of the flow experience itself. Considering the arguments exposed in the previous sections, we will attempt to answer the following two research questions: Will interest play a moderating role in the relationship between challenge/skills balance and flow? Will a non-linear model better explain the relationship between challenge/skills balance, interest and flow than a linear model? We are also interested in addressing these questions at within-subject level, according to the non-ergodic nature of flow.

Therefore, our hypotheses are:

H_1: Interest will play a moderating role in the relationship between challenge/skills balance and flow. Such that, the relationship between challenge/skills balance and flow experience will be stronger under high rather than low levels of interest.

H_2: The relationship between challenge/skills balance and interest (as independent and moderator variables) and flow (as dependent variable) will be better explained using a non-linear model than a linear one.

Method

Participants

The sample consisted of 58 employees from a variety of occupations (lawyer, ballerina, dog trainer, diving instructor, CEO, researcher, office worker, manager, assembly line worker, human resources advisor, law firm partner, architect, clinical nutritionist, clinical psychologist, chef, high school teacher, university professor, marketing director, real estate salesman, sports instructor, travel agent, etc.). The sample was purposefully heterogeneous, composed of 27 men and 31 women with an average age of 38 years of age (ranging from 26 to 64); eight per cent had high school diplomas, 57% had undergraduate degrees, and 35% had postgraduate degrees. On average, the participants worked in the same company for eight years (minimum one month and maximum 43 years); in their current position for an average of six years (minimum one month and maximum 28 years); and they dedicated an average of 8.3 hours a day to work (minimum 4 hours and maximum 14 hours).

Measures and Procedure

The data in this investigation was collected using experience sampling method, across a period of 21 consecutive days, with participants completing an average of 59.8 recordings about work-related flow. Following Bakker's model, and the agreement in the literature about the importance of the challenge/skills balance as a precondition of flow, the key variables measured in this research were challenge, skills, interest, enjoyment and absorption. The participants were asked to complete a Flow Diary when they were instructed (through a PDA system) a total of six times a day, 21 days in a row. The Flow Diary contained the following six items: (1) What activity am I performing at this moment? [the respondent included a brief description of the activity], (2) How challenging do I find this activity? [A little – A lot], (3) What is my skill level for performing this activity? [A little – A lot], (4) How much do I enjoy doing this activity? [A little – A lot], (5) How interesting is this activity? [Slightly interesting – Very interesting], and, finally, (6) How quickly does time pass while I am doing this activity? [Time passes very slowly – Time passes very fast]. All answers, except those to the first question, were given on a scale from 0 to 100 (slider format without anchor in the middle). Considering our research goals we decided to consider only the recordings generated by working tasks (N= 3640 of the total 6982). Some of the results about non-working activities have been reported in Navarro and Ceja (2011).

From these, we calculated the challenge/skills balance (CSB), Flow1, and Flow2 measures. The challenge/skills balance was calculated using Moneta's absolute difference model, where the absolute difference between challenge and skills was subtracted from 100, giving a value for CSB (see Moneta, 2012; Moneta and Csikszentmihalyi, 1996). A score of 100 on CSB means a perfect balance between challenges and skills. Furthermore, Flow1 (the way of measuring flow based on Bakker 2008) was calculated by averaging the results of interest, enjoyment and absorption. Flow2 was calculated by omitting interest from this previous equation and considering the average of absorption and enjoyment only. Both measures of flow showed suitable values of reliability using alpha statistic (0.87 for Flow1; and 0.82 for Flow2).

Data Analysis

The analysis of the data was divided into different stages. All analyses were carried out using R software, with the support of the QuantPsyc and Cusp packages (Fletcher 2012; Grasman, van der Maas, and Wagenmakers 2009). Considering the multilevel nature of the data (i.e. registers nested in individuals) and the ergodic theory explained previously, we did analyses at within-individual level. First of all, a descriptive analysis was conducted to determine the mean, standard deviation, maximum and minimum values of each of the variables (challenge, skills, interest, enjoyment, absorption, CSB, Flow1, and Flow2).

Second, we carried out a correlation analysis. Third, and to test our hypotheses, we carried out a regression analysis and nonlinear analysis (applying cusp catastrophe modelling) on each individual, independently from one another. This means that we did the analysis case per case; in other words, we repeated the same analysis 58 times. We will report the mean values of Adjusted R^2 and fit information criteria indexes (i.e. AICc and BIC) averaging the individual results for each model tested (Model 1, Model 2 and Model 3; see below).

Three regression models were applied in order to test the moderation effect of interest on the relationship between CSB and flow and the possible existence of non-linearities in this relationship. All of these, as we have stated before, were applied at within-individual level. The models consisted of the following:

Model 1: simple regression analysis of challenge, skills and CSB on Flow1 (interest, enjoyment, absorption)[1].

Model 2: moderation analysis of interest in the relation of challenge, skills and CSB on Flow2; where the dependent variable is Flow2, the independent variables are

1 We are aware that there are authors who prefer to work considering as predictor only the CSB (e.g. Engeser and Rheinberg 2008). However, we rather prefer to follow the recommendations made by Moneta (2012) at this point and proposing challenge, skills and CSB as different predictors.

challenge, skills and CSB, and the moderating variable is interest.

Model 3: the same as in Model 2 but applying a cusp-catastrophe model, to explore non-linear relationships among the variables.

Following the hypotheses previously stated, what we expect to find is that Model 2 will explain more variance for the relationship between CSB and Flow than Model 1, because of the introduction of interest as the moderating variable and its extraction from the measurement of flow. Furthermore, we expect to find that Model 3 will explain even more variance than Model 2, considering the non-linear nature of the relation stated in the second hypothesis. These expected increments between models will be determined by the Adjusted R^2 value and fit criteria indexes of each model (i.e. AIC and BIC indexes).

Results

The results from the descriptive analysis are shown in Table 1. Overall, the individuals perceived their skills to be relatively high (*M*= 80.03, *SD*= 17.54) compared to their perceived challenge (*M*= 55.72, *SD*= 27.60). The values obtained for the balance of challenge and skill (CSB), showed that the participants had medium values (*M*= 67.19, *SD*= 25.09). The mean values for Flow1 and Flow2 were relatively high, with participants scoring a mean of around 70 (Flow1: *M*= 69.36, *SD*= 22.59; and Flow2: *M*= 70.15, *SD*= 27.62). The lowest value corresponds to challenge (*M*= 55.72, *SD*= 27.60) and interest, enjoyment and absorption show similar scores (with a mean of around 68 and standard deviation of around 24).

The correlation analysis shows that all the correlation values are statistically significant except the one between skills and challenge. This is due to the fact that this figure was achieved by taking the average of 58 participants, and behind this number are hidden different kinds of relationships (positive, negative and non-significant correlations). Results among interest, enjoyment, and absorption show high as well as significant values (around .

90) that would justify the creation of a global measure of flow considering these as components. The created measures of Flow1 and Flow2 show correlation values with the rest of variables that are statistically significant in all cases (values around .30 - .40 with challenge, skills and CSB, and around .90 with enjoyment, interest and absorption). These two measures, Flow1 and Flow2, show a correlation value of .98 indicating that they are practically a similar measure. Finally the high correlation between challenge and CSB (r = 0.81) should be remarked.

*** INSERT TABLE 1 AROUND HERE ****

As a reminder to the reader, the main hypothesis was that interest would play a moderating role in the relationship between CBS and flow. This means that we predicted that Model 2 would explain more variance than Model 1, given that interest is included as a moderator in the relationship between CSB and flow in Model 2. We also hypothesized that Model 3, a non-linear model, will explain more variance between CSB and flow than Model 2. As a final reminder, we tested all these models at the within-individual level. In Table 2 we show the average fit values of the fifty-eight participants[2]. Model 1, which considers the flow measure as the average of interest, enjoyment, and absorption, presented the worst fit values. This model explains only 33.1% of the variance of the flow measure. The other two models, which consider interest as a moderator in the relationship between CSB and flow, explain much more variance: 50.8% and 67.1%, respectively. Considering specifically Model 2, the interaction term CSB*Interest (the moderator) was significant ($p < 0.01$) in 45 of the 58 participants; in other words, the moderator variable had a significant influence on the relationships between CSB and flow in the 77% of the cases (and the beta estimates were

2 It would be possible to present the results, participant per participant, of the three models tested to appreciate the estimate parameters in each model per each participant. This would have implied to present 174 tables of results (58 participants per 3 models tested), which is not possible to consider here.

positive in all these cases). These results support our first hypothesis (the relationship between challenge/skills balance and flow experience will be stronger under high rather than low levels of interest). Because Model 1 has a different dependent variable (Flow1) than models two and three (Flow2), a formal comparison (e.g., using an analysis of variance) cannot be carried out to test whether the increase from 33.1% to 50.8% - 67.1% of explained variance is significant.

*** INSERT TABLE 2 AROUND HERE ****

Regarding the nonlinear model (Model 3), the percentage of variance accounted for is higher than Model 2 (67.1% versus 50.8%). The information provided by AICc and BIC indexes are also a good indication of the strength of Model 3 over the second model. The AICc and BIC were systematically lower for the third model compared to the second one. These indexes provide an accurate measure of the quality of a statistical model, which provides support for model selection. In this case it was possible to conduct a statistical comparison, using a chi-squared test, which shows that the difference was statistically significant for all the 58 participants ($p < 0.01$). This supports our second hypothesis (the relationship between challenge/skills balance and interest -as independent and moderator variables, and flow -as dependent variable, will be better explained using a non-linear model than a linear one).

In Figure 1 we have chosen two examples (participants 29 and 59) to illustrate the fit of the nonlinear models. We have chosen these two participants considering that their fit values were similar to the produced in the overall sample ($R^2_{participant29} = 0.63$, $AICc_{participant29} = 120$, and $BIC_{participant29} = 136$; $R^2_{participant59} = 0.68$, $AICc_{participant29} = 129$, and $BIC_{participant29} = 144$). These figures show the appearance of a threshold value in the interest variable -when this value is overcome the possibility that the CSB would conduce to flow experience increases significantly. This threshold value is different for each participant. For the full sample, and considering the range of the variable interest (0 to 100), the threshold value was of 67.5.

*** INSERT FIGURE 1 AROUND HERE ***

Discussion

Flow has been thoroughly investigated in the workplace because of its positive effects on workers (e.g., higher well-being). Professional settings are ideal for fostering flow because they provide several conditions which help flow take place. For example, they provide structure and challenges, a stage where they can put their skills to use in order to cope with these challenges. Adults are more likely to experience flow at work than during leisure time, because conditions that enable flow are present on average for 50% of the workday, as opposed to just 18% in the non-work day (Fullagar and Kelloway 2013). Additionally, flow is a popular topic in psychology research because “it taps into a scientifically meaningful concept that is at the same time intuitively understood on the basis of one’s own experience” (Engeser and Schiepe-Tiska 2012 p. 2).

Throughout this research, we have followed several existing trends to distinguish between pre-conditions and the experience of flow itself, which is considered as a crucial area to advance in the field (Delle Fave, Massimini, and Bassi, 2011). In this sense, we have found support to consider interest as an important condition under which the balance between challenge and skills produces flow. In addition to this we argued that the current trend in flow research, which does not comply with the ergodic principle, has been wrongfully applied to flow research for some time. Following this trend as well, in the present study we have considered flow as a non-ergodic phenomenon and analysed our data accordingly (at within-individual level). And in doing so we have found support for the role of interest as a moderator role in the relationship between preconditions of flow and flow experience. Lastly, we have followed in the steps of Ceja and Navarro (2011, 2012), who propose to analyse flow as a nonlinear process, which has allowed us to further confirm their research and increase the percentage of variance explained in our models.

The Moderating Role of Interest

Throughout this research, we have explained in detail two popular ways of contextualizing and measuring flow: Bakker's and Csikszentmihalyi's. The present study contributes to flow theory by challenging Bakker's conventional way of measuring flow in the workplace. For the first time, the three dimensional way of measuring flow (i.e. interest, absorption, and enjoyment) has been broken down to consider interest as a moderator rather than as part of the flow experience itself. This argument can also be applied to Csikszentmihalyi's view when he includes the autotelic nature as a component of the flow experience. Behind the autotelic nature is the idea that people are motivated primarily by the experience itself rather than by the possible extrinsic rewards. In consequence, and according to our results, we must remove this component from the flow experience itself. Instead, it might be considered as a pre-condition for the appearance of flow. When individuals feel intrinsically motivated this will help them approach certain situations which for them are more flow inducing. Not only will their intrinsic motivation play a large role in motivating the individual to carry out this activity, but it will also give them a greater capacity to sustain, enjoy, and repeat this activity.

Moreover, two of the most important and modern theories of work motivation are flow theory and self-determination theory. Both theories share their focus on the behaviour that is initiated and maintained, coming from the person him/herself, rather than as a result of external rewards. This means that they stress the importance of interest as a necessary condition for the appearance of the motivated behaviour. For example, in self-determination theory, the over-justification effect proposes that external rewards dismiss motivation, only if we refer to intrinsic motivation. In a similar way, we have considered that the proposed relationship between CSB and flow experience, will only take place if interest is present. As a consequence, this also means that interest should be removed from the experience of flow itself and should be considered as a moderator instead.

The results of the present study support our first hypothesis: if interest increases, the positive effect of the challenge/skills balance on flow increases as well. On the basis of the evidence obtained from carrying out a simple regression analysis (Model 1) and a moderation analysis (Model 2), we can conclude that the increase in variance explained (from 0.33 to 0.50) is due to the removal of interest from the interest-absorption-enjoyment equation and the role it plays as a moderator in the relationship between challenge/skills balance and flow. Other colleagues (e.g. Eisenberger et al. 2005), have investigated the drive of balance between challenge and skills to achieve flow experiences under certain conditions. One of these conditions has been studied in detail here: when people feel an interest for the activities they are doing.

Non-linear Relations between BCS, Interest and Flow Experiences

The experience of flow changes a person. As challenges are overcome by the acquisition of new skills, a person grows. In order for that person to experience flow again, the same activity must be more challenging every time. If data is collected over time, the change that occurs in an individual must be taken into account in the analysis. To this effect, we have carried out an analysis using nonlinear regression techniques (i.e. cusp catastrophe modelling), which allow us to draw accurate conclusions about the moderating effect of interest on the relationship between CSB and flow. Using this kind of analysis we open the door to the study of sudden, abrupt changes, and not only confine the attention to the study of smooth, gradual and linear changes.

A previous study by Ceja and Navarro (2012) confirms that flow “may present both linear and nonlinear changes at different values of challenge and skills” (Ceja and Navarro 2012, p. 1117). They showed, using the cusp catastrophe model as well, that there are drastic and discontinuous changes in the experience of flow. They also suggested that increase the “evidence of the existence of nonlinear relationships in the process of flow calls for the development and application of nonlinear approaches to the study of this phenomenon” (Ceja and Navarro 2012, p.1118; see also Navarro and Ceja 2011).

Based on these findings, we used a non-linear approach. We have found that the cusp catastrophe model (Model 3) explained more variance than the linear model (Model 2), 67.1% versus 50.8% respectively. Moreover, the fit indexes (AICc and BIC) clearly suggested that the nonlinear model is better than the linear one for all the participants. As a result, we can conclude that our second hypothesis was indeed supported and that relationship between challenge/skills balance, interest and flow is better explained using a non-linear model than linear one.

Ceja and Navarro (2012) have found that flow is especially well modelled using nonlinear techniques that are able to consider sudden changes in the temporal trajectories. It seems that, as experience, the appearance and disappearance of flow happens suddenly. At this point the development of the flow theory should consider flow as a presence-absence phenomena rather than a matter of degree. This can also have consequences in the way we measure flow, for example, using a Likert scale could be better suited for the study of gradual phenomena than for the study of on-off phenomena. We would need other types of scales to measure flow more accurately considering this on-off nature.

Implications for Academics and Practitioners

In the wake of these results, we can conclude three things. First, those who adopt Bakker's three-dimensional approach to research flow at work should consider intrinsic motivation as a moderator rather than as part of the actual experience of flow. Second, flow as a process is non-ergodic, and its research should apply within-subjects designs. Third, research on flow that collects data over time, with recordings for the same individual over a given period, should be better analysed using nonlinear techniques at the within-level (i.e. participant per participant).

Flow, as other theories of intrinsic motivation suggest, should consider interest as separate from the actual experience of flow. The findings obtained in this study have important implications for the use of the WOLF tool as a measurement of flow at work. Therefore, in an academic setting, the WOLF should be used taking into consideration the conclusion drawn from this study: interest should be considered as a moderator for the relationship between CSB and flow.

Aside from the WOLF, another more complete and representative way of measuring flow is the Flow State Scale (FSS) and the Dispositional Flow Scale (DFS) proposed by Jackson and Ecklund (2002), based on Csikszentmihalyi's nine components of flow. We should make the same suggestion about the use of these scales: interest should not be part of the measure of flow experience. Additionally, these tools (FSS and DFS) have the advantage that they are much more holistic in their way of measuring flow, not restricting it only to enjoyment and absorption and they also allow the researcher to measure flow both situationally and dispositionally. However, the current trend in flow theory proposes to distinguish between pre-conditions of flow and the flow experience itself (e.g., Fullagar and Kelloway 2013), a differentiation that is still not present in the FSS and DFS.

Supporting Ceja and Navarro's (2012) claim, this study shows that considering flow as a non-linear process rather than a linear one gives stronger and more accurate results to explain the role of interest as a moderator in the relationship between CSB and flow. Therefore, when modelling flow, it is important to take into account the continuous fluctuations and the appearance of threshold values in which flow changes dramatically due to its on-off nature.

For professionals looking to increase flow amongst workers, this research has important implications. It suggests that a balance between challenge and skills is not sufficient to experience flow, but interest should be stimulated to increase the possibilities of flow. One way can be to encourage workers' three basic needs -autonomy, competence, and relatedness- in new and well-practiced tasks. According to Ryan and Deci, pioneers of the self-determination theory, supporting the individual's experience of autonomy, competence, and relatedness are argued to foster the most volitional and high quality forms of motivation and engagement (Ryan and Deci 2000). Human resource policies should stimulate the creation of work settings in which these needs can be satisfied. Doing so, these policies increase the possibility of experiencing intrinsic motivation (i.e. interest) with the activities at hand and, in consequence, also increase the possibility to experience flow.

Limitations and Future Research

The limitations of this study should help guide future research on flow at work. The sample used in this investigation, although heterogeneous, was rather limited in size (58 participants). A larger sample size could further emphasize the results obtained in this research. Additionally, research has looked into how flow is experienced in different kinds of occupations. For example, Llorens, Salanova and Rodríguez (2012) analysed the difference in flow frequency in schoolteachers and tile workers and discovered that secondary school teachers were more likely to experience flow. It would be interesting, as further research, to investigate the differences in frequency of flow between more than just these two occupations, in order to better understand if the nature of the job affects the experience of flow.

The measurement tool used for this investigation was based on Bakker's (2008) work-related flow inventory, which we have argued thus far is rather simple in nature. In the present study, we have only considered one item per variable studied. Being true that brief questionnaires are necessary in some cases, such as in projects that include many measures (Martin and Jackson 2008) like this research, future research on flow at work should use other, more complex, methods of measuring flow, such as the Situational and Dispositional Flow Scales proposed by Jackson and colleagues (e.g., Jackson and Ecklund 2002; Jackson, Martin, and Eklund 2008).

The item "How quickly does time pass while I am doing this activity?" was previously used to measure absorption by Ceja and Navarro (2011 and 2012). This item could be compared to the time distortion factor proposed by Csikszentmihalyi and reflected in Jackson and Ecklund's flow scales. However, since Csikszentmihalyi speaks of a distortion of time or altered sense of time, rather than time speeding up, we suggest that future research look into the speeding up and slowing down of time because, sometimes, the flow experience is also associated to a major awareness of the passage of time such as the case of sports or jobs that require a precise knowledge of time (Csikszentmihalyi, Abuhamdeh, and Nakamura 2005). As the slowing down of time can also be associated with boredom, this item should be used together with another, which can detect whether time slowed down because a person was absorbed in the activity or bored with it.

Experience sampling method was used to collect the data. This method was the most appropriate way of measuring flow in field studies because it allowed for the studying of flow in the natural work environment and limited the possible bias of retrospection. However, in order to be a successful measurement, it relies on a high level of dedication and commitment on the employee's part probably causing attrition bias in the final sample. The signal contingent method (using alarms) can disrupt the employee's activity, and more importantly, disrupt their flow experience. In this research, participants were asked to answer an average of six times per day, 21 days in a row, which is rather demanding. From the high mean values of enjoyment (66.26), interest (71.54), and absorption (68.33), we can deduce that our sample was composed of motivated and happy employees. A suggestion for future research would be to analyse participants with low levels of flow to see if the results could be repeated.

Conclusions

Although the WOLF measurement has been used extensively in studies looking at flow in the professional environment, we have discovered that explained as is (i.e. enjoyment, absorption, and interest), it does not provide sufficient explanation for the effect of CSB on the experience of flow. We have taken interest out of this equation and considered it as a moderator in this same relationship. Results show that considering interest as a moderator better explains the relationship between CSB and flow, such that the relationship between challenge/skills balance and flow experience will be stronger under high rather than low levels of interest. Furthermore, we have analysed our data using linear, as well as non-linear models, and can conclude that this relationship is better explained by using the latter. Following the call by Ceja and Navarro (2012) for the use of nonlinear models to study flow at work, we hope that our findings encourage other researchers to approach flow as the complex, dynamic process that it is.

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Tables and Figure

Table 1: Descriptive statistics and correlations among measures.

	Min	Mean	SD	Max	Challenge	Skill	CSB	Enjoyment	Interest	Absorption	Flow1	Flow2
Challenge	0	55,72	27,60	100	1	0.01	0.81**	0.41**	0.49**	0.27**	0.44**	0.37**
Skill	2	80,03	17,54	100		1	-0.31**	0.32**	0.21**	0.34**	0.32**	0.36**
CSB	0	67,19	25,09	100			1	0.31**	0.41**	0.17**	0.33**	0.26**
Enjoyment	0	66,26	25,50	100				1	0.84**	0.69**	0.93**	0.92**
Interest	0	71,54	24,11	100					1	0.64**	0.92**	0.81**
Absorption	0	68,33	22,51	100						1	0.86**	0.91**
Flow1	0	69,36	22,59	100							1	0.98**
Flow2	0	70,15	27,62	100								1

Note. N= 3 640; . ** $p < 0.01$.

Table 2: Regression, moderation and non-linear model analyses.

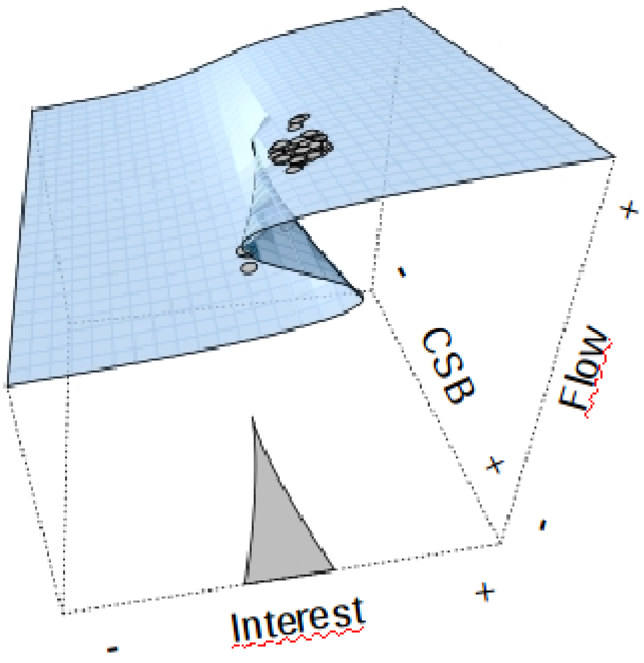
	Average Adjusted R^2	Average AICc	Average BIC	p
Model 1	0.331 (0.240)	NA	NA	
Model 2	0.508 (0.239)	432,5 (151,20)	442,48 (154,57)	
Model 3	0.671 (0.207)	94,82 (59,33)	107,28 (61,50)	< 0.01

Notes: We present the average values of the 58 participants. In brackets we show the standard deviation around these average values. The minimum average Adjusted R^2 for Model 1 was -0.032, the maximum 0.677; for Model 2 the minimum Adjusted R^2 was 0.115 and the maximum 0.969; for Model 3, the minimum Adjusted R^2 was 0.126 and maximum 0.944. The p values show the significant difference between Model 2 and Model 3 considering the AICc and BIC indexes.

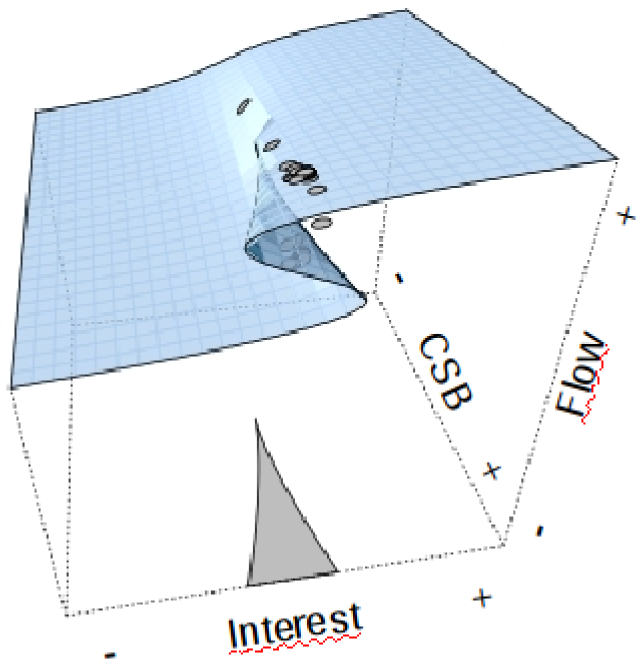
NA = Not available

Figure 1: Three-dimension representation of cusp models for two illustrative examples (Participants 29 & 59).

Participant 29



Participant 59



Appendix 1

R-codes of all models:

Model 1: lm(Flow1 ~ Challenge + Skill + CSB)

Model 2: lm(Flow2 ~ Challenge + Skill + CSB:Interest)

Model 3: cusp(y ~ Flow2, alpha ~ Interest, beta ~ Challenge + Skill + CSB)