THE DYNAMIC RELATIONSHIP BETWEEN AGING AND JOB PERFORMANCE – A CASE STUDY

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Abstract: Organizational psychologists are striving to create global models that can explain and predict organizational behaviour. In this quest, there have been elaborated many meta-analyses that gather relevant findings in order to create a conceptual framework of understanding human performance. This paper presents arguments for sustaining the curvilinear relationship hypothesis that occur between aging and job performance in an organizational context research. Conclusions set up a new conceptualization of the variable dynamic relationship inferences in Psychology.

Key words: organizational psychology, dznamic system, human performance, organizational context.

1. Dynamic systems in organizational psychology

Organizational and industrial psychologists have focused on linear explanations, where the output of a system is proportional to its inputs. This type of relationship assumes a simple system, whose processes can be measured and understood, but most systems in nature are nonlinear, outputs in this case are not proportional to inputs. A small input to a complex system can produce a small, moderate or even large effect. The processing taking place in these systems is intricate and difficult to explain.

In the classical view, parts of a system are in many cases assumed to be independent. Independence assumes that a part of the system is compartmentalized, insulated from the rest of the system to which it belongs. The cognitive science postulation of separate modules

in the brain that are dedicated to processing specific information is an example of independence. The outcome can always be predicted, regardless of the overall state of the system.

The dynamical systems view can account for complex interactions between modules, because it sees the parts of a system as interdependent. In this case, a part of the system's performance is dependent on the state of the entire system; how it operates in one state is different from how it might operate when the system is in another state, thus the system is analytically understood.

Researchers in organizational and industrial psychology that examine the behavior of the different pieces of a system and then put these separate descriptions together to explain the behavior of the whole are acting in a manner of reductionist approach. When systems resist reductionist explanations and cannot be broken down into pieces, they function in a holistic manner. Every piece relies on the parts around it to function properly as described by the gestalt psychologists, "the whole is greater than the sum of its parts". Emergence is a property of these kinds of holistic systems.

Instead, the dynamical systems approach sees the systems as open that cannot be considered independent of its surroundings. The employee is part of an organization that is in turn part of the world and treating them as an open system means taking into account "external" factors such as social and personal factors, thus employees influence organizations and organizations influence employees.

The independence traditional approach has a linear view of causality, where variables affect others in a sequential manner. The best way to visualize this is as a chain of arrows where variable A affects B, which then affects variable C. The dynamical systems approach is that

variables can have all sorts of causal relations that act concurrently, as the result of feedback, where a variable's output at one point in time can alter the future activity of both itself and many other related variables.

Thus, dynamical systems takes a long-term view of system action, since feedback can alter not just what happens in the immediate moment following a cause, but over the entire future course of the system's behavior. Feedback mechanisms can promote the maintenance of homeostasis, but they more often produce increases, decreases, oscillations, fluctuations, and other sorts of dynamic processes that change with time. So while the traditional view sees short term immediate effects, the dynamical systems view sees long-term dynamical effects (Friedenberg, J., 2009).

The classical view in all sciences was that the world is operating according to deterministic rules and if we know these laws/rules and we have sufficient information as to the state of a system, then we can predict with accuracy how the system will behave in a long-term perspective and most of all we can control the system.

Dynamical systems theory also acknowledges that there are deterministic rules that govern a system's behavior, but these knowledge of starting conditions are not sufficient to allow complete long-term prediction. Even if we have exhaustive knowledge of a system's starting state and we are able to predict its future behavior, over time though, the behavior will diverge from our prediction no matter how accurate our starting observations are. Thus, dynamical systems allow only for partial understanding and control.

If the traditional systems would not allowed sudden changes, only gradually and slowly over long periods of time, the dynamical systems perspective allows for such sudden and rapid change, when

system's arrival at a critical point. This critical point is represented by the conditions under which a system surpasses a complete and decisive change. As we will further see in the result of our research, the relationship between job performance and aging cannot steadily, continuously and linearly behave over time.

Thus, shortly defined a dynamic system represents a system of elements that change over time. All dynamic systems share common several properties, such as: self-organization, hierarchical organization of nested structure, reciprocal and circular cause, non-linear dynamics, perturbation, the process of a phase transition. Thus, the individual employee cannot be isolated from work environment, nor can the constituent elements be neglected (Bălaș-Timar, D., 2014).

Referring to research in organizational psychology, there has been evidence that employee well-being is a dynamic process that undergoes continuous changes. As employees go through positive and negative experiences, they are continuously shifting from positive to negative states of consciousness (Beal and Ghandour, 2010; Heller, Watson and Ilies, 2006). When employee well-being is studied longitudinally over short periods of time, it shows continuous fluctuations and changes across time (Ilies, Dimotakis and De Pater, 2010; Sonnentag, 2003; Ilies, Schwind, & Heller, 2007; Bakker, 2005; Demerouti, 2006). Several researchers have found that employee flourishing tends to behave in a nonlinear way (Ceja and Navarro, 2009, 2011; Guastello and Liebovitch, 2009; Losada and Heaphy, 2004).

Organizational researchers are following a nonlinear dynamical systems approach, which considers nonlinearity and discontinuous change, to study employee happiness and well-being (Ceja and Navarro, 2009, 2011; Guastello, 2002; Karanika-Murray and Cox, 2010).

Although there has been found evidence that employee well-being presents continuous changes over time, there is still a need to model these fluctuating dynamics. Catastrophe theory can offer an accurate approximation for understanding these dynamical changes (Ceja and Navarro, 2009). Catastrophe theory has provided successful approximations for other organizational processes, such as work motivation (Guastello, 1995), employee turnover (Sheridan, 1985; Sheridan and Abelson, 1983), decision making (Wright, 1983), personnel selection (Guastello, 1995), organizational change (Bigelow, 1982), and competitive dynamics (Kauffman and Oliva, 1994). However, it is difficult to test such models directly in work environments.

While there is evidence that work-related flow is highly dynamic and presents nonlinear changes, most research on flow in the workplace has been based on traditional between-variance models (Bakker, 2005; Demerouti, 2006; Eisenberger, Jones, Stinglhamber, Shanock and Randall, 2005; Salanova, Bakker and Llorens, 2006) and techniques based on linear model (Fullagar and Kelloway, 2009; Makikangas, Bakker, Aunola, Demerouti, 2010).

As we have seen, non-linearity allows for the occurrence of radical phenomena, such as sudden phase shifts as a function of continuous changes in independent variables, deterministic but unpredictable chaotic behavior and self-organization or improbable spontaneous coherent behavior.

2. Aging and job performance – a literature review

Current workforce participation trends suggest that the mean age of the workforce is increasing in industrialized countries. Americans who are 55 and older will comprise 25% of the US workforce by the year

2020 (Toossi, 2009, 2012); similar trends have been observed in the UK (Taylor & Urwin, 1999) and other European countries as well (Anxo, Ericson, & Jolivet, 2012). These conclusions trigered increased academic research on the effects of age on job performance. While previous reviews have identified group differences in job performance between older and younger workers (McEvoy & Cascio, 1989; Ng & Feldman, 2008; Sturman, 2003; Waldman & Avolio, 1986), the present review addresses the role age plays, in organizational life.

In an article written about the effect age has on performance in the workplace Mumtaz (2010) explains reasons why employers think that older workers are lower workplace performance. Mumtaz describes how resistance to new technology is causing less flexiblility in new working conditions. Citizenship behavior also decreases as age increases because older employees feel like they need to spend more time worrying about their own work to make sure their employers don't think their performance is decreasing rather then are willing to assist new workers who need help. Conducting a study using over 100 groups of individuals with ages between 18 to 74, Mumtaz aimed measuring how work performance is affected by experience compared to age. Supervisors were asked to fill out a questionnaire, which rated employee performance. In this study they were able to conclude that the correlations between age and performance drops significantly when experience was controlled. This means that once experience is added into the equation performance is dependent upon how much experience the employee has. Avolio (1990) also explains how the length of experience that the employee has represents a better predictor of work performance then age.

In the most recent review of age differences in job performance, Ng and Feldman (2008) observed that there are not significant age

differences between younger and older workers in terms of core task performance. The current review extends to locate the sources of those differences and to explain how age can contribute to job performance beyond the execution of core task duties. This perspective redresses some of the imbalance in previous research which has tended to ignore the effects of within-person changes related to aging on performance.

Ng and Feldman's (2008) review found that age was not significantly related to core task performance but was related positively to citizenship behavior and negatively to counterproductive work behavior. In the case of core task performance, authors suggest that declines in information-processing speed are frequently counteracted by increases in experience-based judgment, resulting in smaller and less consistent decrements in core task performance over time.

3. A case study on aging and job performance relationship

Archival data from 51 current employees who completed tests as part of the employment selection process are included in this study. Data was gathered for job applicants being hired between 18.05.2010 and 16.09.2013. These archival data were collected in March 2014. The archival data include demographic information and organizational data. Of the participants, 56.9% are male. Regarding the hiring year 5.9% became employees in 2010, 19.6% became employees in 2011, 33% became employees in 2012 and 41.2 % became employees in 2013. Employees are aged between 25 and 39. The range of incomes varies from 1.800 Ron (Young graduate) to 37.957 Ron (Production Manager).

Job performance regards the appreciated performance on a 1 to 5 scale (where 1 stands for - does not meet standards and 5 for - exceeds standards) for the following aspects: 1) job specific knowledge, 2)

quality/quantity of work, 3) communications, 4) interpersonal skills, 5) organization, planning and process thinking, 6) judgment and decision making, 7) customer satisfaction, 8) teamwork, 9) adaptability to change, 10) management of human resources (not required for non-supervisory associates) and 11) performance against objectives (optional – attach performance objectives).

For example, *Specific knowledge work context related* was defined as the ability to understand, use and demonstrate technical concepts effectively, meet operating procedures and legal requirements in all aspects; keeping abreast of current developments and trends in area of expertise. Assessors (direct hierarchical supervisor) have ranked this performance criterion by using behavioral anchored scales:

1. Regularly make mistakes because of wrong knowledge on certain standards in complex aspects of the job; shows few signs of improvement, despite previous advice.

2. Holds technical information and/or operating on some standard issues (may be defective occasionally, leading to poor performance) may not be versed in all aspects of the complex processes. Would not normally expect other people to go to this person for technical or operational information because these knowledge gaps. This person should go to others for information rather than perform inadequately due to gaps.

3. General knowledge about all aspects of owning and operating the technical standard of their own job. Would be expected occasionally to double check procedures with others on the most complex tasks.

4. Holds general knowledge of technical and operating procedures for all aspects of their own job and those who are in close contact with it. If you need a person to know both the standard and

alternative procedures for carrying out any aspect of this job, you can think of that person as a source.

5. Display specific knowledge and innovative capacity of technical concepts and operating procedures for even the most complex tasks. Most people in the department consider this person an expert on a variety of specific jobs department.

Testing for normal distribution of data, for job performance variable, the Kolmogorov-Smirnov coefficient is significant at a p value $p > .05$ which indicates normal distribution.

The main purpose of current study is to highlight the relationship between job performance and aging inside an industrial multinational company from Arad (51 technical and administrative staff). The present study takes the position that job performance – age relationship is a dynamic one, these considerations leading to **Hypothesis: Job performance and aging are in a dynamic relationship.**

In curvilinear relationships variables grow together until they reach a certain point (positive relationship) and then one of them increases while the other decreases (negative relationship) or vice versa (Aron et al, 2011; Jackson, 2006). This relationship can be easily identified graphically by a Scatterplot, choosing additional two representations of the regression line: Linear and Quadratic model.

The Scatterplot diagram presented in Figure 1, demonstrates curvilinear relationship between employee's age on the horizontal axis and job performance, represented on the vertical axis. The sample consists of 51 employees, aged between 25 and 39 years.

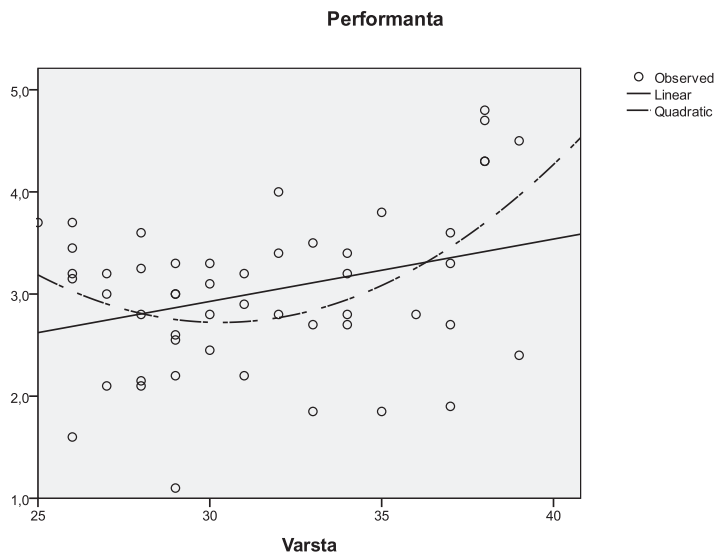

Figure 1 – The curvilinear relationship between age (varsta) and job performance (performanta)

In order to demonstrate this relationship, we have introduced in the hierarchical regression analysis model job performance as the dependent variable. In step 1, we have entered employees' age, and in step 2 we have introduced a newly created variable, squared age.

Table 1 – *Regression analysis of aging and job performance*

Descriptive Statistics

	Mean	Std. Deviation	N
Job performance	3,020	,7865	51
Age	31,51	4,120	51
Sqared age	1009,5098	265,47304	51

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	,320[a]	,102	**,084**	,7527	,102	5,588	1	49	**,022**
2	,446[b]	,199	**,166**	,7184	,097	5,803	1	48	**,020**

a. Predictors: (Constant), Age

b. Predictors: (Constant), Age, Squared age

ANOVA[c]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	3,166	1	3,166	5,588	**,022[a]**
	Residual	27,764	49	,567		
	Total	30,930	50			
2	Regression	6,161	2	3,080	5,969	**,005[b]**
	Residual	24,770	48	,516		
	Total	30,930	50			

a. Predictors: (Constant), Age

b. Predictors: (Constant), Age, Squared age

c. Dependent Variable: Job performance

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Correlations		
		B	Std. Error	Beta			Zero-order	Partial	Part
1	(Constant)	1,095	,821		1,334	,188			
	Age	,061	,026	,320	2,364	,022	,320	,320	,320
2	(Constant)	17,877	7,010		2,550	,014			
	Age	-1,000	,441	**-5,237**	-2,267	**,028**	,320	-,311	-,293
	Age Squared	,016	,007	**5,566**	2,409	**,020**	,337	,328	,311

a. Dependent Variable: Job performance

Excluded Variables[b]

Model		Beta In	t	Sig.	Partial Correlation	Collinearity Statistics		
						Tolerance	VIF	Minimum Tolerance
1	Age Squared	5,566[a]	2,409	,020	,328	,003	320,028	,003

a. Predictors in the Model: (Constant), Age

b. Dependent Variable: Job performance

We note that for both steps coefficients are statistically significant at $p < 0,02$, $F = 5,588$ for step 1 and $F = 5,969$ for step 2,

which provides consistency. Although the data clearly demonstrate collinearity, the tolerance threshold is well below the permissible limit, this result is somewhat expected, given the almost perfect correlation between age and squared age.

What actually demonstrates curvilinear relationship between age and job performance is the changing sign in step 2 of Beta coefficient in the linear regression model. Beta coefficient for age changes from –5,237 into 5,566 when age is squared, both coefficients being statistically significant at $p < 0,02$. In our case study, according to this curvilinear relationship, employees aged 25 are associated with above average job performance (3 on a scale from 1 to 5) then there is an immediate decrease in job performance to around 2,5 which actually represents the average performance. This situation is highlighted in Figure 1, when studying job performance's behavior around the age of 31. Job performance starts to grow after the age of 31, slowly at first, then obviously at the age of 39, when it still increases, according to estimates.

One limit of this study is that age interval of employees stretches from 25 to 39. It would be interesting to study how the relationship between age and job performance behaves afterwards.

4. Conclusions and implications

Given the dominant role that older workers currently play in the labor market it is important that we understand how to shape employment relationships.

Generally, age effects are small and non-linear, but are likely masked by the fact that most researchers have yet to sample truly older (i.e., 50 years plus) workers. Most likely, an inverted U-shaped relationship exists between age and job performance (McDaniel, M.A.,

Pesta, B.J. & Banks, G.C. 2012). As authors suggest, the effects might probably be moderated by job complexity and whether experience with specific job content can buffer against expected age-related physical and cognitive decline.

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