International Journal of Industrial Ergonomics 56 (2016) 106–114

Contents lists available at ScienceDirect

International Journal of Industrial Ergonomics

journal homepage: www.elsevier.com/locate/ergon

The effects of group size and task complexity on deadline reactivity

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ARTICLE INFO

Article history:
Received 14 February 2015
Received in revised form
8 September 2016
Accepted 27 September 2016
Available online 7 October 2016

Keywords:
Deadline rush
Deadline reactivity
Parkinson's law
Task complexity
Group size

ABSTRACT

In contemporary organizations, people are often required to work and learn under increasing time pressures as organizations set deadlines in order to respond to stiffer competition. Human behavioral patterns in the presence of deadlines have been studied quantitatively to show that relatively little time is devoted to tasks early on and that most work is performed in close time proximity to a deadline. This phenomenon, called *deadline rush*, can be explained by a hyperbolic behavioral model. By employing a decision-making task based on an Anti-Air Warfare Coordinator (AAWC) simulator, the experiment had two group size levels (individuals and teams) and two task complexity levels (low and high). The experimental results showed that deadline reactivity is greater for individuals than teams on low-complexity tasks and task complexity is negatively related to deadline reactivity. The results of this study suggest that different group sizes and task types have a significant impact on production performance and that the setting of deadlines, to the degree possible, may be a relevant means towards managing or improving system performance.

1. Introduction

In contemporary organizations, people are often required to work and learn under increasing time pressures as organizations set deadlines in order to respond to stiffer competition. Time is one of several potentially scarce resources that might be better managed or operationalized in order to improve organizational efficiency and effectiveness (Bluedorn and Denhardt, 1988). One of the more observable time-management devices found in practice is the ubiquitous use of deadlines for both cognitive and manual work. Deadlines are known to increase productivity by encouraging workers to manage time efficiently, yet there are many unaddressed questions regarding the appropriate setting and performance of deadlines (Höffler and Schwartz, 2011; Maule and Svenson, 1993).

Parkinson's Law (1957) famously states that "*work expands so as to fill the time available for its completion*." This statement can also be transformed in relation to deadlines, wherein having less time to complete a task results in completing the work at a faster pace. Quantitatively, it is known that longer deadlines cause work pace to slow and that work pace increases as deadlines approach (Fried and Slowik, 2004). For example, Waller et al. (2002) conducted an experiment with 38 groups that had either static or dynamic deadlines. They showed that for all groups, an approaching deadline motivated them to increase their pace under both static and dynamic deadlines. Others have found similar behaviors, wherein people pay more attention to time under deadline constraints, motivating them to pace themselves appropriately (Gersick, 1988, 1989).

Such deadline pacing is further related to the concept of goal setting, which is defined as "the object or aim of an action, for example, to attain a specific standard or proficiency, usually within a specified time limit" (Locke and Latham, 2002). Over 40 years of empirical research, goal setting, among other motivation theories, has been shown to be one of the more robust, valid, and practical approaches for modeling organizational behavior; in applying goal-setting theory, researchers have discovered many relationships between goals and performance (see Locke & Latham, 2002). One basic relationship shows that goals that are both specific and

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http://dx.doi.org/10.1016/j.ergon.2016.09.011
0169-8141/

challenging tend to lead to higher performance than goals that are not (e.g., Austin and Klein, 1996; Locke and Latham, 2002; Locke et al., 1981). Goal setting theory has a time-related characteristic in that it aggregates motivation over time and uses deadlines as goals for task completion. It states that deadlines help pace effort and increase the motivational effects of goals; when too much time is allowed, the pace is delayed and then speeds up as deadlines approach (Bluedorn & Denhardt, 1988; Fried and Slowik, 2004). Thus, goal setting has close conceptual similarities with deadline setting, in that individuals respond differently with respect to the proximity of the goal or deadline.

Human behavioral patterns in the presence of deadlines and goals have been studied quantitatively to show that relatively little time is devoted to tasks early on and that most of the work is performed in close time proximity to the deadline. This phenomenon, called *deadline rush*, may be represented by specific models that predict little early activity followed by a sharp increase in activity immediately prior to the deadline (König and Kleinmann, 2005). Deadline rush can be explained by time discounting meaning that "people attribute less value to options that are available only in the future than to options that are immediately available (König and Kleinmann, 2006)".

One model for quantifying deadline rush is the hyperbolic deadline reactivity model, which has been shown to fit performance data before deadlines (König and Kleinmann, 2005). The hyperbolic model of deadline rush uses the function in Equation (1),

$$V = A/(1 + KD) \quad (1)$$

where V is the instantaneous work rate (units/time), D is a time of the deadline, and A is an upper bound on the work rate representing the pace of the worker undiscounted by the deadline rush effect (units/time). The parameter K denotes the slope of the hyperbolic function and is used as an index of the extent to which individuals discount the value of future outcomes, an individual difference variable. In other words, higher values of K indicate more pronounced discounting of work pace and more reactive workers (Fig. 1, solid line), whereas a smaller value of K represents less reactive workers who are productive at every point in time (Fig. 1, dashed line). More reactive workers will present their behavior as consistent with Parkinson's Law (Gutierrez and Kouvelis, 1991).

In addition to the mathematical explanation, a more categorical and conceptual means of modeling deadline reactivity can be found in the notion of pacing style. This conceptual model can be categorized into three main modal styles according to how individual behavior is distributed over time in working towards deadlines

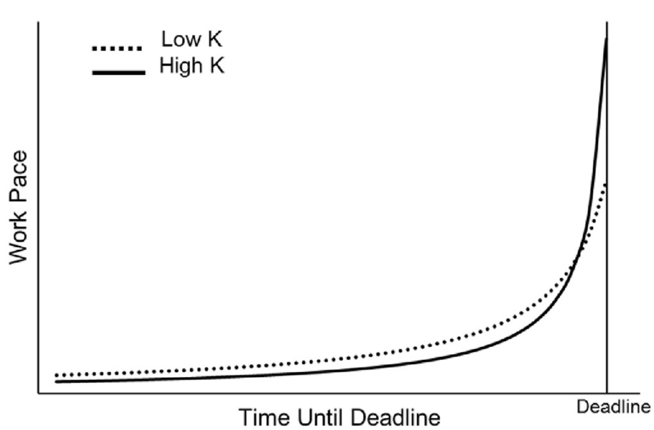

Fig. 1. Hyperbolic Curve before the deadline.

(Gevers et al., 2006; 2015; Mohammed & Harrison, 2013). The first of these modal styles is *early* action style, in which a person starts a task right away and finishes long before the deadline. The second is *deadline* action style, in which a person waits until the deadline is imminent to begin and completes the bulk of the work at one time until that time runs out. Third, in the *steady* action style, an individual demonstrates a constant pace by spreading his or her effort out evenly over the time available. The notion of pacing style has been studied in conceptual-based qualitative constructs, and recently Gevers et al. (2015) developed a more quantitative measure to validate the concept. However, this scale-based method is based on self-reports, which are inherently qualitative in nature. Thus, there still exist limited studies that actually track time distribution quantitatively based on mathematical models.

While individual differences in temporal activity can be a fundamental component of group functioning, the team level in time distributions is equally valuable to examine (Mohammed and Harrison, 2013). Gersick (1988) found that teams also follow Parkinson's Law in relation to deadlines. Specifically, when groups were given a specific deadline for completing a project, little progress was made on the project during the first half of the period before the deadline; subsequently, major efforts were undertaken during the latter half of the period prior to the deadline. This relation existed regardless of the total time for project completion. On the other hand, in a team-level study, time scarcity has been known to induce lower task quality. Karau and Kelly (1992) investigated the effect of time scarcity and abundance on group performance by comparing the studied groups' written solutions for a given problem on the basis of the frequencies with which quality content appears, including consideration of originality, creativity, and adequacy. Among the groups given scare, optimal, and abundant time, the time-scarcity group performed at the lowest level in originality, creativity, and adequacy.

Despite the usefulness of the findings described, most of the previous team-level research has not focused on how time distribution relates to deadlines, but rather has focused on perception of deadlines, time urgency, time orientation, and the average amount of the temporal construct (e.g., Souitaris and Maestro, 2010; Waller et al., 1999, 2001; West and Meyer, 1997). Also, there are no direct studies that compare individuals' versus groups' time distribution prior to a deadline. Previous studies have shown that performance by teams is better than performance by individuals in learning, creating (See Hill, 1982), and decision making tasks (Cooper and Kagel, 2005; Kocher and Sutter, 2005; Schmidt et al., 2001). Nonetheless, the pacing of the relative efforts of individuals and groups has not been previously evaluated. The higher performance of groups is somewhat suggestive that teams perhaps engage in greater effort earlier, or farther from the deadline, and are less reactive than individuals. Thus, the question of how pacing compares between individuals and teams in the presence of deadlines leads to the first of our research hypotheses.

H1: Deadline reactivity is greater for individuals than for teams.

Performance by both individuals and teams may be influenced by task complexity which is known as a significant factor for estimating human behavior. Task complexity has no single widely accepted definition; rather, it can be defined in many ways (see Liu and Li, 2012). One approach is to view task complexity as being related to the number of elements of the task (Wood, 1986). A complex task may have many task elements and may have task elements that interconnect with each other. In addition, the number of goals and pathways to goals can be used to define task complexity. That is to say, a complex task may have many goals, and there may be many means to attaining each goal (Kelly et al., 1990;