Personality and Individual Differences 104 (2017) 434–441

Contents lists available at ScienceDirect

Personality and Individual Differences

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

The Spearman's law of diminishing returns in chess

Angel Blanch [a,b,*], Héctor García [a], Anton Llaveria [a], Anton Aluja [a,b]

[a] Department of Psychology, University of Lleida, Spain
[b] Institute of Biomedical Research (IRB Lleida), Spain

ARTICLE INFO

Article history:
Received 29 June 2016
Received in revised form 2 September 2016
Accepted 5 September 2016
Available online xxxx

Keywords:
Spearman's law of diminishing returns
Chess
Cognitive tasks

ABSTRACT

The Spearman's law of diminishing returns (SLODR) contends that a general factor of cognitive ability (g) is more efficient to account for individual differences in intellectual performance in low ability than in high ability groups. Several works support the SLODR, albeit other studies have questioned it with one of the main criticisms being the splitting up between low and high ability groups. This study evaluates the SLODR with data from the chess domain with the Amsterdam chess test (ACT). Chess ability relates closely with several cognitive abilities that load in g, whereas the Elo chess rating is a robust quantitative indicator of chess skill that is suitable to determine differentiated ability groups. A structural equation model with five subtests from the ACT for low and high Elo chess rating groups indicated a better overall model fit for the low ability group. Factor invariance analyses about the variance explained by g, residual variances, and g-loadings, indicated that the highest variation between low and high chess ability groups arose in the model constraining equal g-loadings between both groups. These findings supported the SLODR in chess.

1. Introduction

The Spearman's law of diminishing returns (SLODR) affirms that a general factor of cognitive ability (g) contributes in a lesser extent to explaining individual differences in intellectual performance for high-ability than for low-ability groups (Detterman & Daniel, 1989; Spearman, 1927). Several studies support the SLODR with a variety of samples and test batteries (Abad, Colom, Juan-Espinosa, & García, 2003; Coyle & Rindermann, 2013; Deary et al., 1996; Jensen, 2003; Kane, 2000; Nyborg & Jensen, 2000). In contrast, unsupportive evidence argues that the SLODR ignores task complexity (Fogarty & Stankov, 1995), depends on reliability differences and on the cutoff points to determining ability groups (Hartmann & Teasdale, 2005), or relies mostly on using traditional analytical methods (Murray, Dixon, & Johnson, 2013). The SLODR has been addressed with tests of several cognitive abilities under intelligence evaluation conditions. However, if the SLODR is universal then it should be observed within any intellectually demanding domain. For instance, the question may be raised on whether the SLODR holds in an intellectually demanding activity such as chess.

There are robust connections between cognitive abilities and chess performance (Grabner, 2014), with remarkable differences in brain activity between amateur and expert chess players when playing chess (Amidzic, Rielhe, Fehr, Wienbruch, & Elbert, 2001; Bilalic, Langner, Erb, & Grodd, 2010; Campitelli, Gobet, & Parker, 2005; Duan et al., 2012; Grabner, Neubauer, & Stern, 2006; Saariluoma, Karlsson, Lyytinen, Teräs, & Geisler, 2004). These brain functioning differences underlie a stunning advantage of expert over amateur players in knowledge about the most usual patterns during a chess game, the creation of large chess configurations stored in long-term memory, the resolution of complex problems, and a better neural efficiency. Moreover, there are also meaningful differences between amateur and expert players in abilities loading onto psychometric g, such as processing speed, memory, general sequential reasoning, and visualization and perceptual abilities. Time constraints imposed on chess playing deteriorate chess moves quality for weaker players more than for stronger players, while experts are faster and more accurate in choosing the best moves (Calderwood, Klein, & Crandall, 1988; Charness, Reingold, Pomplun, & Stampe, 2001; Kiesel, Kunde, Pohl, Berner, & Hoffmann, 2009). Stronger players are also better than weaker players are at recalling chess positions, and use highly specialized search and integration abilities of more patterns with complex chess pieces configurations (Gobet & Simon, 1998, 2000; Lane & Robertson, 1979; Schneider, Gruber, Gold, & Opwis, 1993).

This body of evidence suggests that there may be some analogue entity to psychometric g such as a general chess ability, which could emerge from the positive manifold of narrower abilities useful to succeed in the chess domain. Similarly to the IQ, the Elo chess rating captures this general chess ability accurately (Van der Maas & Wagenmakers, 2005). The Elo chess rating quantifies the level of expertise in chess, with higher Elo scores denoting a higher level of chess ability (Elo, 1978; Glickman, 1995). All chess players participating regularly

* Correspondence to: A. Blanch, Department of Pedagogy and Psychology, Faculty of Education, Psychology and Social Work, University of Lleida, Avda de l'Estudi General, 4, 25001 Lleida, Catalonia, Spain.
E-mail address: ablanch@pip.udl.cat (A. Blanch).

http://dx.doi.org/10.1016/j.paid.2016.09.003
0191-8869/

in chess tournaments have an Elo rating, which updates from the outcomes in rated tournaments. Wins against stronger players increase the own Elo rating, loses against weaker players decrease the own Elo rating.

One of the main criticisms about the SLODR relates with the splitting of the sample into low and high ability groups in accordance with the individual scores to a given psychometric test (Murray et al., 2013). The Elo rating circumvents this limitation because it can be used as an external criterion of chess expertise to determining low and high chess ability groups. On the other hand, psychometric instruments addressing chess ability are scarce. One notable exception is the Amsterdam chess test (ACT) (Van der Maas & Wagenmakers, 2005), a psychometric measure of chess playing proficiency. The ACT is a reliable and valid instrument developed with a group of active chess players that addresses different aspects of the game, including ability and motivational factors. The aim of the present study was to evaluate whether the SLODR holds in the applied domain of chess. The SLODR was therefore examined with the data on chess abilities used to develop the ACT.

2. Method

2.1. Participants

The participants in this study were 259 chess players undergoing a ten days open chess tournament in 1998 in Dieren, the Netherlands, who completed the Amsterdam Chess Test, ACT (Van der Maas & Wagenmakers, 2005). For the present study, players with missing data in any of the employed measures were removed from the current analyses. This resulted in a group of 225 chess players (15 females) with an age range between 8 and 70 years old ($M = 30.39$, $Sd = 14.97$).

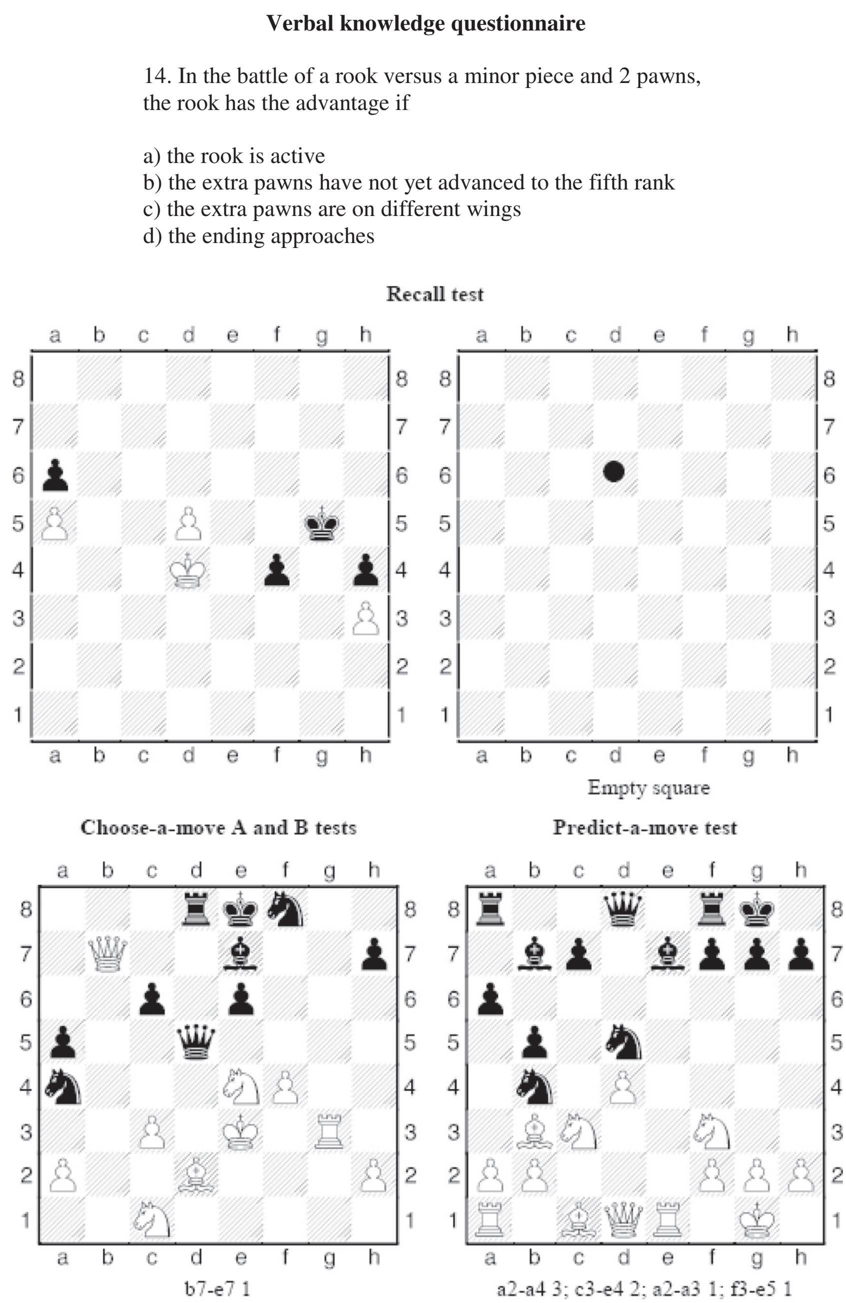

Fig. 1. Four sample items from the subtests in the Amsterdam Chess Test.