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The effect of monetary compensation on cognitive training outcomes

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ABSTRACT

Recent work has established the possibility that messaging and incentive during recruitment may influence the outcome of cognitive training. These factors may impact intrinsic and extrinsic motivation to complete a training intervention, and one provocative single session study suggests that recruitment messaging may be responsible for an expectancy effect in certain training experiments. To examine the effects of payment and payment messaging during recruitment on a longer training program, participants were recruited to complete a twenty-session working memory regimen with or without payment, and with messaging that either emphasized payment or improving cognition. Significant group differences were observed at baseline; unpaid participants reported a significantly higher number of cognitive failures compared to compensated participants. However, both paid and unpaid training groups improved on transfer measures compared to an active control group, and payment had no effect on transfer. An additional post-test survey within the compensated group revealed different motivational orientations that were associated with significant performance differences on the visuospatial reasoning factor at baseline. While these differences in motivation were not predictive of transfer or training gain, it is possible that other elements of the study, including researcher involvement, may also play a role in determining the extent to which participants demonstrate transfer on untrained tasks. We conclude that while payment and recruitment messaging may affect training and transfer performance to some degree, a variety of additional factors likely contribute to the outcome of any individual study and the influence of certain factors may matter less during a longer-term program.

1. Introduction

The goal of cognitive training is to improve a single cognitive skill, or a set of skills, that would then increase performance across a wide range of untrained tasks that draw on those skills. However, outcomes from cognitive training studies are often mixed. It is common for only some individuals to benefit from the intervention, and it is largely unknown what individual-difference factors play a role in the success of these interventions. Thus, the determination of which factors moderate task-based improvements and transfer following cognitive training, and by how much, is an important question. Although a wide variety of factors, such as the degree of

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researcher involvement, subject setting, training duration, and feedback to participants have been proposed as potential moderators of improvements (Jaeggi, Buschkuehl, Shah, & Jonides, 2014), motivational orientation has been shown to be an important factor in determining the success of cognitive interventions and learning more generally (Pintrich, 1999). This approach has only fairly recently been explored in the context of cognitive training research (Prins, Dovis, Ponsioen, Ten Brink, & Van der Oord, 2011). The goal of the present study was to investigate the impact of monetary compensation and motivation on the outcome of one widely used cognitive training intervention: working memory (WM) training.

One potential explanation for differences in outcomes across studies is monetary compensation, which may impact one's motivation to complete a task (Murayama, Matsumoto, Izuma, & Matsumoto., 2010). Many WM training studies have utilized the dual n-back task, which requires participants to judge whether items presented in an auditory stream are the same as those presented n-items previously and simultaneously judge whether locations presented in a spatial stream are the same as those presented n-items previously. As participants succeed at a particular n-level, n is incrementally increased. Training on this difficult, adaptive WM task was found in one prominent study to lead to improvements in a measure of fluid intelligence (Gf; Jaeggi, Buschkuehl, Jonides, & Perrig, 2008). Although other studies have also found transfer to fluid intelligence or related visuospatial reasoning measures (Colom et al., 2013; Jaeggi, Buschkuehl, Jonides, & Shah, 2011; Jaeggi et al., 2014; Jaušovec & Jaušovec, 2012; Rudebeck, Bor, Ormond, O'Reilly, & Lee, 2012; Schweizer, Hampsire, & Dalgleish, 2011; Stephenson & Halpern, 2013), other studies have not replicated these transfer effects (Chooi & Thompson, 2012; Redick et al., 2013; Thompson et al., 2013), and near transfer effects appear to occur much more consistently than far transfer effects (Melby-Lervåg & Hulme, 2013). There are now so many studies of this nature that even the number of meta-analyses is fairly numerous. Unfortunately, they too often arrive at different conclusions depending on the methodology used and studies included (Au et al., 2014; Melby-Lervåg & Hulme, 2013; Melby-Lervåg, Redick, & Hulme, 2016; Weicker, Villringer, & Thöne-Otto, 2016), suggesting that there might be individual differences or other factors that impact the training outcome (Katz, Jones, Shah, Buschkuehl, & Jaeggi, 2016; Jaeggi et al., 2014).

Additionally, the potential underlying mechanisms of any transfer effects remain a significant open question. Jaeggi and colleagues initially suggested that the improvements to measures of fluid intelligence may be due to improvements in a common capacity constraint shared by fluid intelligence and working memory (Jaeggi et al., 2008). It is possible, for example, that these capacities are connected through attentional control processes, such as inhibitory control, and that extensive training on working memory tasks may improve these processes (Novick, Hussey, Teubner-Rhodes, Harbison, & Bunting, 2013; Jarosz & Wiley, 2012; Wiley & Jarosz, 2012). It also remains possible that transfer effects, when they do occur, are related to strategy development during the training (Morrison & Chein, 2011). However, a large body of subsequent work has raised substantial questions about the underlying processes that support improvements on untrained tasks following training, and it remains unclear which mechanisms, or combinations of mechanisms, may be involved. (Jaeggi, Buschkuehl, Jonides, & Shah, 2012).

Furthermore, we propose that for WM training, as in a wide range of learning tasks, the degree to which individuals are intrinsically motivated will have a substantial impact on learning, performance, and achievement (Benware & Deci, 1984; Condry & Chambers, 1978; Lin, McKeachie, & Kim, 2001; Spence & Helmreich, 1983). Participants who lack intrinsic motivation are less attentive and more distractible (Fransson, 1977), do not maximize effort (Vollmeyer & Rheinberg, 2000), and are more likely to disengage when a task becomes difficult (Dev, 1997). There is evidence that extrinsic reward may have a deleterious effect on compliance in completing repetitive cognitive tasks (Murayama et al., 2010) as well as reducing performance on attentional measures (Robinson et al., 2012). Additionally, the existence of extrinsic motivators, such as payment for participation, may undermine intrinsic motivation in a wide range of contexts (Blumenfeld, Kempler, & Krajcik, 2006; Henderlong & Lepper, 2002; Pittman & Heller, 1987; Tang & Hall, 1995). However, evidence in support of the hypothesis that extrinsic rewards undermine performance is mixed. While a meta-analysis by Deci, Koestner, and Ryan (1999) did identify a negative impact of extrinsic reward on self-determination and therefore intrinsic motivation, another meta-analysis by Cameron and Pierce (1994) found inconsistent effects of extrinsic reward on intrinsic motivation. Furthermore, individual differences may moderate the degree to which extrinsic factors may have an undermining effect. For example, Robinson et al. (2012) suggest that individuals who express very high intrinsic motivation may be less susceptible to the negative effects of providing an extrinsic reward. Finally, not all extrinsic rewards are alike: nominal extrinsic rewards, such as a small trinket or cash prize of only a few dollars, may not negatively impact intrinsic motivation (Ross, 1975). Additionally, only tangible rewards, such as money or physical prizes, have been shown to consistently undermine intrinsic motivation (Deci, 1971, 1972; Reeve & Deci, 1996; Swann & Pittman, 1977).

Given that the impact of extrinsic rewards is complex and dependent on a variety of factors, including individual differences, the type of extrinsic reward, and the type of task, it may be valuable to consider the influence of extrinsic rewards in the context of WM training and its effects on transfer. In other fields, such as exercise compliance, some researchers suggest that extrinsic foci may reduce one's intrinsic motivation to adhere to a training regimen (Frederick-Recascino & Ryan, 1995). However, because WM training studies are often time-intensive and challenging for participants, researchers frequently provide substantial payment. More than $100 has been provided to participants in many of these studies as a means of recruitment (Anguera et al., 2012; Kundu, Sutterer, Emrich, & Postle, 2013; Redick et al., 2013; Rudebeck et al., 2012; Schweizer et al., 2011; Thompson et al., 2013). Other studies have provided nominal or no payment to subjects for their participation (Jaeggi et al., 2008, 2014; Jaušovec & Jaušovec, 2012; Stepankova et al., 2014; Stephenson & Halpern, 2013). Compensation in these studies is often contingent simply on compliance or on a per-session basis (Redick et al., 2013); as discussed in the review of the motivation literature above, some researchers have suggested that this compensation method may negatively impact intrinsic motivation, and thus performance on the tasks and assessments (Deci et al., 1999). One recent meta-analysis of dual n-back training research provides some evidence that compensation may be negatively correlated with transfer gains, although this effect did not remain significant following the removal of outliers (Au et al., 2014). Of course, these WM training studies also differ on other dimensions as well, and it remains difficult to determine why