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FACULTY OF SPORT, EDUCATION AND SOCIAL SCIENCES

# Order effects in assessments of sporting ability

by

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## ABSTRACT

FACULTY OF SPORT, EDUCATION, AND SOCIAL SCIENCES

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# ORDER EFFECTS IN ASSESSMENTS OF SPORTING ABILITY

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Research (e.g. McKelvie, 1990) has shown that order of information can influence judgments. In light of equivocal findings in this research, Hogarth and Einhorn (1992) developed their belief-adjustment model to present a more detailed approach to predicting order effects. Greenlees, Dicks, Thelwell and Holder (2007) were the first to test the predictions of the belief-adjustment model in sport. The aim of this thesis was to extend Greenlees et al.'s work through a more systematic examination of order effects in sport. Specifically, the aims were to examine the generalisability of Greenlees et al.'s findings, to examine the impact of differing processing strategies on order effects, to investigate the influence of personality traits, and to consider variables that might offset order effects. To achieve these aims, four experimental studies were conducted.

In Study 1, ultimate frisbee players watched DVD footage of two players (a control and target player) performing a catching and throwing drill, and assessed the ability of each target player. Participants viewed the same footage for the control player. For the target player, participants viewed the same footage, with half viewing a declining (successful to unsuccessful) performance pattern, and half viewing an ascending pattern. Study 1 found primacy effects when participants made one end-of-sequence (EoS) judgment. In addition, step-by-step (SbS) judgments eliminated primacy effects. Study 1 also controlled for the time delay inherent in making the SbS judgments, and found that SbS processing, rather than the time delays, eliminated order effects.

Study 2 examined the effect of individual differences on order effects. Using the same methodology as in Study 1, the impact of participants' theory of learning, level of motivation to think, and level of experience were examined. In the EoS condition,

primacy effects were displayed regardless of participants' theory of learning belief, and regardless of level of experience. However, in the EoS condition, primacy effects were only displayed by participants with high motivation to think. Studies 3 and 4 examined the impact of situational manipulations on order effects. The results of Study 3 revealed primacy effects in the EoS condition, regardless of level of accountability. Study 4 revealed recency effects when an interpolated task was carried out half way between viewing the footage.

This research provides support for Hogarth and Einhorn's (1992) model when applied to assessments of ability in sport. Overall, the findings suggest that primacy effects can influence assessments of ability when EoS judgments are required. This has applied implications for those who make assessments of ability; who should be aware that early information might bias their overall judgments of players they observe. The results also suggest that SbS processing offsets this primacy bias, and thus using such additional processing strategies might be an applied suggestion to offset the primacy bias.

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# DECLARATION OF AUTHORSHIP

I, MATTHEW SMITH

declare that the thesis entitled

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and the work presented in the thesis are both my own, and have been generated by me as the result of my own original research. I confirm that:

- this work was done wholly or mainly while in candidature for a research degree at this University;
- where any part of this thesis has previously been submitted for a degree or any other qualification at this University or any other institution, this has been clearly stated;
- where I have consulted the published work of others, this is always clearly attributed;
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- I have acknowledged all main sources of help;
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- parts of this work have been published as: [see following page]

Signed:

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# CHAPTER 1

# INTRODUCTION

Person perception, the way we perceive others, has been much studied since the seminal work of Asch (1946). Asch's pioneering series of studies investigated how impressions of a stimulus person were derived from lists of character traits, and also explored whether the order in which characteristics of a target person were presented had an effect on impressions formed. Human judgment has been seen to be sensitive to the order in which individuals receive information (Richter & Kruglanski, 1998). When the information early in a sequence is disproportionately influential, the effect is known as primacy; at other times, later information can exert a greater influence, and this is termed a recency effect (Bergus, Levin, & Elstein, 2002). Asch found evidence for primacy effects in person perception, with individuals basing their judgments more on initial pieces of evidence they viewed.

Following Asch's (1946) investigations, a large body of research across a variety of domains has investigated order effects. The findings of early research were largely equivocal, with primacy effects observed in some studies (e.g. Anderson & Barrios, 1961; McKelvie, 1990) and recency effects emerging in others (e.g. Ashton & Ashton, 1988; Tubbs, Messier, & Knechel, 1990). In considering the contrasting findings in order effect research, Hogarth and Einhorn (1992) developed a belief-adjustment model. This conceptual framework seeks to explain conditions in which certain order effects occur. Hogarth and Einhorn proposed that an initial impression (an anchor) is formed when early information is viewed, and this impression is adjusted as new evidence is evaluated. The model offers six factors that determine the presence and direction of order effects. The principal factor is the mode of processing information, with Hogarth and Einhorn predicting that when a single judgment is made at the end of the sequence of evidence, primacy effects will emerge. However, recency effects are predicted when the anchor is adjusted after every piece of information, in a step-by-step processing mode. Hogarth and Einhorn proposed that in the step-by-step mode, people are forced to pay similar attention to all evidence in a sequence. Thus, later information is weighted more heavily than earlier information, and recency is predicted.

The other factors in the belief-adjustment model include the response mode required, whether evidence is in a long or short series, whether evidence is simple or complex, whether evidence is mixed or consistent, and whether an evaluation or estimation response is required. Further predictions of the model include that long series of information result in primacy effects, and recency effects occur when more complex information is assessed. The predictions made by the belief-adjustment model, and the way various factors interact to produce order effects, are summarised in Table 2.1 (see page 31). Support for the predictions of the belief-adjustment model has been found across a variety of domains, for example, in clinical judgments (e.g. Chapman, Bergus, & Elstein, 1996), personnel decision-making (e.g. Highhouse & Gallo, 1997), and military decision-making (e.g. Aldeman, Tolcott, & Bresnick, 1993).

A limited amount of research has also investigated the influence of order effects on assessments of ability, with primacy effects the principle finding (e.g., Jones, Rock, Shaver, Goethals, & Ward, 1968; Allen & Feldman, 1974; McAndrew, 1981). Assessments of ability can be defined as a perceiver's cognitive representations of certain qualities, which might allow a target person to perform certain tasks successfully. Over a series of studies, Jones and his colleagues examined participants' perceptions of a target person's ability to solve logic problem-solving questions. When the target person was viewed having early success before a decline in performance, participants judged the target to have higher ability compared to when they started poorly and then seen to improve. In replications of Jones' research, further evidence of primacy effects has emerged when judging a target person's ability from solving intelligence problems (Newtson & Rindner, 1979; McAndrew, 1981; Benasssi, 1982). Primacy effects have also been revealed in an educational setting (Allen & Feldman, 1974) with order of information influencing tutors' perceptions of students' ability.

Until recently, no research had addressed order effects in sport. This is somewhat surprising considering judgments concerning ability and performance are regularly made in sport, with all sporting participants frequently assessed throughout their career. In some sports (e.g. gymnastics, trampolining) judges assess performance to provide specific gradings to determine overall finishing positions. Journalists and commentators regularly make assessments of players in their reports, and players and coaches make judgments of opponents' ability, which might inform their decisions on appropriate strategy. Furthermore, coaches and managers watch players in training or competition to make decisions on whom to buy or recruit for their squads, and from game to game, who should make the starting line-up. Consequently, it appears crucial that impressions of players' ability and performance are not biased by any internal or external factors (Plessner & Haar, 2006).

Greenlees, Dicks, Thelwell, and Holder (2007) sought to address the gap in the order effects literature by investigating the influence of order effects on ability assessments in sport. Greenlees and colleagues showed footage to soccer players and coaches of a target soccer player performing a simple passing task. All participants viewed the same eight video clips, with half viewing a declining (successful to unsuccessful) performance pattern, and half viewing an ascending pattern. Primacy effects emerged, with the player's ability rated significantly higher in the successful/unsuccessful condition. Furthermore, primacy effects occurred regardless of the judgment condition or participants' level of experience. These findings are consistent with previous studies of order effects in ability assessments, and suggest primacy effects in assessments of ability are a fairly robust finding. Nevertheless, Greenlees et al. acknowledged that their study was conducted within a specific sporting population, and therefore proposed the need for more widespread research to investigate whether their results would replicate in a different sporting domain. Furthermore, Greenlees et al. suggested further research might examine other conditions that influence order effects, for example, moderating variables that might offset primacy effects.

The aim of this thesis was, therefore, to extend the work of Greenlees and his colleagues by providing a more systematic examination of order effects in the sporting domain. In addition to seeking to replicate Greenlees et al.'s findings, the programme of research sought to explore situations in which order effects occur in sport, and variables (both situational and personal) that influence the strength and direction of order effects. The findings will have applied implications for those who make judgments of players' level of ability levels in sport. With a fuller understanding of situations in which order effects occur when making sporting judgments, applied recommendations can be made to reduce potential biases when making judgments of ability.

## OVERVIEW OF THESIS

This thesis consists of seven chapters. Chapter 2 provides a review of literature, drawing on theory and research that has examined order effects in the impression formation literature. This chapter presents the historical progression of research into order effects, and examines theories that researchers have presented to explain why order effects occur. In addition, this chapter assesses the findings of order effect research across a variety of domains, and evaluates in more detail order effects research concerning ability assessments. Furthermore, this chapter will explore variables that might moderate the influence of order effects.

Chapters 3 to 6 investigate the influence of order effects when making assessments of sporting ability, testing the predictions of Hogarth and Einhorn's (1992) belief-adjustment model in a sporting context. Chapter 3 extends the work of Greenlees and colleagues (2007) by replicating their study in a different sport (ultimate frisbee). This chapter also explores whether the delay between pieces of evidence influences the order effects found. Chapter 4 examines whether certain personality variables moderate order effects. Chapter 5 investigates the influence of participants' level of accountability on order effects in the end-of-sequence judgment condition. Chapter 6 examines the impact of an interpolated activity on order effects in the end-of-sequence condition. Finally, Chapter 7 (general discussion and conclusions) provides an overview of the findings in Chapters 3 to 6, discusses the implications for coaches and other individuals who make assessments of ability in sport, and highlights areas for future order effects research.

# CHAPTER 2

## REVIEW OF LITERATURE

Social cognition refers to the thought processes in which we interpret, analyse, and use information around the social world (Baron & Bryne, 2002). Within the social psychology literature, interpersonal perceptions, the way people develop impressions of another, have been extensively researched (Jones, 1996). Impression formation is the process by which observers integrate various sources of information into a unified consistent judgment. Social cognition theorists (e.g., Fiske & Neuberg, 1990) have proposed when people enter into social interactions, information is sought to help predict how these interactions are likely to progress and conclude. Forming impressions is viewed as a dynamic process, with judgments continually updated in response to new information (Franzoi, 2000). However, there are limits on our capacity to think about others and process information. As such, we adapt shortcuts designed to save mental effort and preserve cognitive capacity (Jonas et al., 2001), which reduces cognitive effort in processing information, but can lead to errors in one's thoughts about others.

In social psychology, a large body of research has examined factors that influence the way individuals make judgments of others. In an experimental setting, Chaplin et al., (2000) investigated the impact of different types of handshakes on impressions formed. Findings revealed that a firm handshake produced more positive impressions, and this effect was magnified for women who provided such a handshake. In a study concerning perceptions of ability in the workplace, Heilman and Stopeck (1985) found that attractive male executives were considered more able than less attractive ones. In a further study, Mueller and Mazur (1996) found teenage boys, whose facial appearance was perceived to be dominant and assertive, achieved higher rank attainment in the military. In sporting judgments, impressions have been influenced by the colour of clothing (Frank & Gilovich, 1988), reputation (Findlay & Ste-Marie, 2004), and body language and sport-specific clothing (Greenlees et al., 2005).

Aronson, Wilson, and Akert (2005) describe how a person forms impressions of another quickly and effortlessly without much conscious analysis of this process. This involves a process of automatic thinking, which allows a person to understand new situations by relating them to prior experiences. These mental structures, or schemas, help people organise knowledge about the social world around them (Fiske &Taylor, 1991). A schema is a 'cognitive structure that represents knowledge about a concept or type of stimulus, including its attributes and the relation between those attributes' (Fiske & Taylor, 1991, p. 98). For example, in sport, a schema for a "good player" could comprise of the type of clothing they wear, and certain aspects of their physical appearance.

When schemas are applied to members of a social group such as gender or race, they are commonly referred to as stereotypes (Aronson et al., 2005). Payne (2001) investigated whether people's stereotypes about African Americans can influence their perceptions on whether people are holding a weapon. Participants were shown pictures of people with white and black faces, and then were shown follow-up pictures in which they were asked whether they saw a gun or a tool. The results showed people were significantly more likely to mis-identify a tool as a gun when it was preceded by a black face rather than a white face. In another study, Correll, Park, Judd, and Wittenbrink (2002) asked participants to play a video game in which they saw young men in settings such as a park or a train station. Half of the men viewed in the footage were white, and half were African American. Half the men in each group were holding a handgun, with the other half holding a non-threatening object such as a phone or camera. Participants were instructed to press a button labelled "shoot" if the man had a gun, and "don't shoot" if they did not. The results showed that participants were significantly more likely to press the "shoot" button when the person in the picture was black. In both studies, participants had to respond quickly to the stimuli, consequently, they had little time to control their responses, or to think fully about their actions. Thus, the results indicated stereotypical attitudes about African Americans and violence. In sport, stereotypes about gender (Coulomb-Cabagno, Rascle, & Souchon, 2005) and race (Stone, Perry, & Darley, 1997) have been shown to influence judgments made concerning sporting performance.

Social cognition follows a framework of information processing, which investigates the way information is processed, and how this leads to people making judgments and decisions (Bless et al., 2004). Baron and Bryne (2002) suggest that sometimes people are successful in their attempts to understand others, but often they make errors in these attempts. Evidence suggests that schemas and stereotypes can lead to errors being made, due to automatic thinking (e.g., Payne, 2001; Correll et al., 2002). Furthermore, researchers in the social psychology literature have identified a number of systematic errors (biases) in the way social judgments are made (Plessner & Haar, 2006). Indeed, in a review of the social cognition literature, Funder (2003) highlighted 39 different biases that have been reported. For example, the fundamental attribution error is one such bias, which refers to a tendency to overestimate the impact of dispositional cues on others' behaviour (Baron & Bryne, 2002).

In social psychology, one such bias that can impact on a person's judgments is the order effect. An order effect is said to occur when a person's judgment is sensitive to the order in which evidence has been presented (Asch, 1946). The specific types of order effect are described as primacy and recency; a primacy effect occurs when judgments are disproportionally influenced by evidence presented earlier in a sequence, and a recency effect occurs when judgments are disproportionally influenced by evidence later in a sequence (Highhouse & Gallo, 1997). In a classic study in impression formation, Asch (1946) investigated how order of information impacted on a person's impressions of another. From Asch's work, a large body of research on order effects has following to investigate whether primacy or recency effects impact on people's judgments in a variety of situations, across a variety of domains.

## ASCH'S WORK AND THE HISTORICAL PROGRESSION OF ORDER EFFECTS RESEARCH

Solomon Asch (1946) explored the way impressions of people are formed and developed. In his work, Asch sought to more fully understand and explain how humans develop perceptions of other human beings. Asch considered how impressions are formed quickly and easily, and proposed first impressions can be enhanced or diminished depending on subsequent information. Consequently, Asch was interested in examining how people form an overall impression of others, in spite of the number of diverse characteristics other people have.

Asch (1946) conducted a series of studies to investigate how people form impressions of others, and whether the order of presenting characteristics influenced impressions formed. Asch was interested in examining whether identical sets of characteristics would produce a constant impression, or if altering the order of these characteristics might change this impression. In the first of this series of studies, Asch presented six adjectives (intelligent-industrious-impulsive-critical-stubborn-envious), which were said to describe a target person. The adjectives were presented in order from favourable to unfavourable, and vice versa. Participants were then asked to write a brief paragraph to summarise the impression they had formed of the target person. Participants were also provided with an additional 18 pairs of adjectives (one positive and one negative, e.g. unpopular/popular) and instructed to chose the one from each pair they felt best characterised the target person. Asch reported that participants receiving the favourable-unfavourable list perceived the target person more positively compared to those receiving the opposite list. These results provided evidence of a primacy effect, indicating that impressions of people may depend more on initial compared to later information.

Asch (1946) conducted a similar study with a different series of adjectives (intelligent-skillful-industrious-determined-practical-cautious-evasive) to further investigate this primacy effect. The results again showed a definite tendency to primacy, as the series starting with the positive characteristics created a more favourable impression. Asch proposed that when a person forms an impression of another, each trait interacts with one or more of the others, and the overall impression is the summation of these effects. In light of this theorising, Asch presented the 'directed impression hypothesis' to explain his findings. He postulated that primacy effects occurred as early adjectives from the list set up a direction or context to which the other adjectives are fitted. In addition, Asch suggested the initial adjectives produced a certain expectancy, and subsequent adjectives were interpreted in line with this expectancy. For example, Asch suggested that the adjective 'impulsive' in his sequence could be interpreted positively or negatively, depending on the expectancy developed by earlier adjectives. This implied that for social interactions, one's overall impressions of another person might be influenced by the order in which the characteristics of that person are observed.

Asch's (1946) studies provided the first evidence of order effects in impression formation. However, a number of limitations were observed. Luchins (1948) highlighted the measures used involved participants having to choose between extreme characteristics, which didn't allow an accurate impression to be formed. Asch himself acknowledged the procedures he used were very different from everyday situations in which people make judgments of others, stating that impressions were 'weak, incipient... based on abbreviated descriptions of personal qualities' (p.261). Moreover, Luchins proposed that Asch's research design failed to make the transition from the experimental situations used to real-life situations. Thus, Luchins questioned whether Asch's procedures were relevant to more natural judgments made in everyday life. Asch maintained his procedures had merit for investigating changes in impressions, arguing that developing impressions from lists of trait-characteristics is a partial aspect of the broader process involved in making natural judgments of others. Certainly though, Asch's work provided the springboard for a subsequent body of research into order effects, that has been conducted in a range of situations, and across a variety of domains.

Luchins (1957) aimed to build on Asch's (1946) work by carrying out a further series of studies to investigate order effects in impression formation. Instead of the discrete traits used in Asch's research, Luchins used written paragraphs. Luchins manipulated the order in which these descriptions were presented to examine whether contrasting orders of the descriptive information influenced the judgments made about an individual. In a series of studies, participants read two paragraphs describing a target person's behaviour. One of the paragraphs reported the target person exhibiting friendly, outgoing behaviour (extrovert description), whereas the other reported the target person behaving in a more withdrawn, shy manner (introvert description). Luchins examined whether impressions would be more influenced by the first half of information (a primacy effect), the second half (recency effect), or whether equal weight would be given to both halves. The information was presented to participants in a booklet form, with the descriptions either with the extrovert passage followed by the introvert passage, or vice versa. Participants were then asked to make ratings on various personality traits to give their impressions of the target person. The results showed evidence of primacy effects, with the first paragraph having greater influence on participants' ratings. For example, when the extrovert passage was presented before the introvert passage, the target person was rated as significantly more friendly than when the paragraphs were presented in the opposite order.

Findings of primacy effects in Luchins' (1957) initial study were only based on one task, and Luchins acknowledged this gave a limited view of the participants' impressions, and consequently, he conducted two more studies. In one of these studies, participants were asked to write a paragraph to more fully convey their impressions of the target person.

Student assistants judged these written responses and categorised them with regards to the extent the responses were in line with the extrovert or introvert paragraphs. In another study, a broader questionnaire was developed to determine participants' impressions of the target person. The results of these additional studies supported the initial finding of the first paragraph having a greater influence on impressions formed.

Luchins (1957) suggested that participants might not have approached the two blocks of information in the same manner, probably reading the first paragraph with more of an open mind. He proposed the 'interference phenomena' as an explanation for the primacy effects he found. When participants read the second paragraph, this might have been influenced by previous learning from reading the first paragraph. Similar to Asch's (1946) 'directed impression hypothesis', Luchins postulated that early information may have interfered with interpretations of the second paragraph. Thus, primacy effects would be a consequence of this interference. In addition, Luchins speculated that participants paid more attention to the initial evidence. Consequently, once subjects had derived information about the target person from early information, remaining information may have been regarded as less important and less attention was paid to it.

With results revealing primacy effects, Luchins (1957) became interested in exploring ways primacy effects might be weakened or even eliminated. Using the same materials as in the preceding experiments, groups were additionally given either a warning about primacy effects or an interpolated task before making their assessments. In the warning condition, participants were told how initial opinions formed were likely to be held throughout a period of acquaintance, despite contradicting later actions. Participants were then allowed to discuss this idea before being further instructed to suspend their judgments until they had read all the information. In the interpolated warning condition, participants were given this same warning between reading the two written paragraphs. The interpolated number task involved participants solving simple mathematical problems between reading the two paragraphs. The results revealed both the interpolated warning and the interpolated activity were effective for reducing primacy effects. Luchins hypothesised that the interpolation created a break between the blocks of information, which consequently made it less likely that information was perceived as a homogeneous unit. Furthermore, Luchins proposed the interpolated number task successfully reduced primacy effects as it was not related to information presented and thus made for a sharper break between the two written passages.

Luchins' (1957) explanations, however, can be questioned with regards to whether the warning and interpolated activity simply reduced the strength of primacy, or actually created a full shift towards recency. Luchins used phrases such as "trend towards primacy" (p.54), "primacy was more pronounced" (p.54), and "more effective in weakening primacy" (p.70) to describe his results. A weakness of this and other early order effects research was the way the results were interpreted, as inferential statistics were not used in the analyses. Consequently, while Luchins' and Asch's (1946) research appear to offer evidence of primacy effects, these findings should be treated with caution due to the limitations in the statistical analyses employed.

Following these early studies on impression formation, Anderson and various colleagues looked to extend the body of research concerning order effects. Anderson and Barrios (1961) presented participants with lists of adjectives describing a target person, including the list used in Asch's (1946) original study. Participants were then asked to give their impressions of the target person on a (-4 to +4) rating scale of favourability. The results supported the findings of Asch's study, with strong primacy effects found overall, and for Asch's list of adjectives in particular. Anderson and Norman (1964) conducted a study examining four impression formation tasks, to investigate order effects in three other classes of stimuli besides personality adjectives. Findings from these studies revealed primacy effects when using adjectives describing a person, foods describing a meal, and headlines describing a newspaper. The authors offered an alternative to Asch's 'directed impression hypothesis' to explain primacy effects. They argued that a more likely explanation for primacy is that latter items do not change meaning, but simply carry less weight in the impression than earlier items. Thus, primacy effects occurred as participants paid more attention to earlier information in the sequence.

Anderson and Hubert (1963) suggested that the existence of primacy effects had now been confirmed, but the cause of these effects were not yet certain. Anderson and Hubert suggested primacy effects could result from participants paying less attention to later adjectives in a set. To test this proposed explanation, participants in Anderson and Hubert's study were instructed not only to give their impressions, but also to recall the adjectives after making their judgments. Thus, knowing they had to recall each adjective forced participants to pay attention to all adjectives in each set. The results showed primacy effects for the standard impression task, but these primacy effects were eliminated or recency took its place when subjects expected a recall test for the list of adjectives. Anderson and Hubert offered these results as support for attention decrement, suggesting that attention reduced as successive information was presented. They proposed that earlier information exerted more influence, as less attention was paid to later information. However, when recall was asked for, increased attention was given to later information, and thus, the weight of later information was greater.

Anderson (1965) found further evidence of primacy effects when presenting participants with sets of adjective arranged in positive-negative and negative-positive order. The study involved a varying number of positive and negative adjectives in each sequence, and found primacy effects, with the net influence of an adjective decreasing linearly with its ordinal position in the set. Anderson (1965) offered these results as evidence of a weighted-average model. He proposed that each piece of information has a weighting on the overall judgment made, and that primacy effects occur due to greater weighting given to the terms early in the list due to increased attention to this earlier information (Anderson & Hubert, 1963). In addition, Anderson and Jacobson (1965) proposed that primacy effects emerged due to the discounting of later information. They suggested participants viewed later information as unreliable or invalid indicators of the overall impression, if this information contrasted with early evidence viewed. Having made an initial judgment to which a person feels committed, the dissonance created by disconfirming subsequent information is reduced by ignoring or devaluing it (Walster & Presthold, 1966). Thus, later information is discounted and earlier information has a greater influence on impressions formed.

Anderson (1981) brought together the various explanations for order effects in his Information Integration Theory (IIT). Anderson suggested that human judgments result from the evaluation and combination of information about judged objects. IIT describes the way information is processed in order to develop an overall judgment. The theory involves a series of evaluation processes, which integrates two internal parameters. The first parameter is the scale value, which refers to an item of information to be judged. The second parameter is the weight value of the information, which refers to the importance or relevance of each item. Once the stimulus information has been evaluated, the weight and scale values are combined to form an overall judgment, with the final judgment a weighted average of the individual pieces of information. Using the IIT as a framework, a primacy effect would be observed when the first pieces of information are given a higher weighting. This bias might occur when earlier stimuli are considered more central to the judgment and leads to the discounting of later stimuli, especially when the information presented is of a mixed nature. Recency effects are observed when the last pieces of information are given a higher weighting. Anderson (1981) stated that primacy and recency effects are due to attention; this process affects the weight of a stimulus at each particular position. If a response is elicited at the end of the presentation, attention is considered to decrease across the sequence causing a primacy effect. If a response is elicited after each stimulus is presented, attention is considered to increase across the sequence causing a recency effect.

Some criticisms of Anderson's (1981) model have been raised. Wang (2005) suggested the IIT fails to specify what factors affect the attention decrement. Furthermore, Hogarth and Einhorn (1992) point to research revealing recency effects when both a single judgment is made after all information is viewed, and also when responses are made after viewing each individual stimulus. Hogarth and Einhorn identify that although Anderson's theory describes decreasing attention as an explanation for primacy, the theory fails to offer an explanation for why recency effects occur in the end-of-sequence condition, where there is no accounting for additional processing.

Until 1992, there were diverse findings in order effects research, and various theorising for why both primacy and recency effects occur in impression formation. The early work of Asch (1946) and a subsequent body of research that followed indicated primacy effects were a fairly robust finding. In the industrial/organisational psychology literature, some texts argue that primacy effects predominate (Dipboye, Smith, & Howell, 1994; Smither, 1994). Indeed, Nisbett and Ross (1980) suggested that while order of information presented has at times revealed a recency effect on final judgments, and sometimes no effect at all, they concluded that "several decades of psychological research have shown that primacy effects are overwhelmingly more probable" (p.172). However, more recent research has provided greater evidence of recency effects (e.g. Ashton & Ashton, 1988; Tubbs, Messier, & Knechel, 1990). For example, Nisbett and Ross' statement concerning primacy effects has been contradicted by Davis' (1984) review of studies of jury decision making that indicated a greater tendency towards recency, and Patel's (2001) findings of prevalent recency effects in his review of order effects in auditing judgments. In evaluating 76 studies that had explored order effects, Hogarth and Einhorn (1992) found primacy effects emerged in 36 studies, 35 found recency effects, and five found no effect for order of presentation. Thus, it may be premature to conclude that one effect (i.e., primacy or recency) predominates (Highhouse & Gallo, 1997). Hogarth and Einhorn sought to address and explain these diverse findings, and aimed to bring order to the literature that has examined order effects in impression formation tasks. Consequently, Hogarth and Einhorn proposed their belief-adjustment model as a practical, theoretical framework to explain the divergent findings in the order effects research.

## HOGARTH AND EINHORN'S BELIEF-ADJUSTMENT MODEL

Hogarth and Einhorn (1992) presented a more detailed approach to predicting order effects with their belief-adjustment model. According to this model, an initial impression (an anchor) is formed after the first piece of evidence viewed, and this impression is adjusted as new information is presented, depending on how strongly this information confirms or disconfirms the initial impression. Thus, the model predicts people will anchor on their current judgment position, and then adjust their beliefs depending on the strength or direction of each new piece of information. Hogarth and Einhorn proposed the presence of primary or recency effects is dependent on six factors: when judgments are made (end-of-sequence or step-by-step); the mode of information processing (end-of-sequence or step-by-step); whether the sequence of information is long or short; the complexity of the information; whether the judgment is an evaluation or an estimation; and whether evidence is mixed or consistent. The conceptual framework provided by the belief-adjustment model predicts primacy or recency as a function of the interaction between these various factors. The predictions of Hogarth and Einhorn's model, and how these factors interact to produce order effects, are summarised in Table 2.1 (page 31).

Hogarth and Einhorn's (1992) theory of belief-updating involves an anchoring and adjustment process.

This can be written in algebraic terms as

$S_k = S_{k-1} + w_k[s(x_k) - R]$

*where*

$S_k$ = The belief after evaluating k pieces of evidence

$S_{k-1}$ = prior impression or anchor (maybe also based on earlier evidence)

$s(x_k)$ = an individual's subjective evaluation of a certain piece (*k*th piece) of evidence.

$w_k$ = the adjustment weight of a piece (the *k*th piece) of evidence.

$R$ = The reference point against which the impact of evidence is evaluated.

To summarise this equation, a final judgement ($S_k$) is made from taking the current anchor

($S_{k-1}$), and adjusting the anchor in light of succeeding pieces of evidence ($w_k[s(x_k) - R]$). This adjustment is dependent on an individual's own assessment of that piece of evidence [$s(x_k)$], and the weighting ($w_k$) of that evidence. The model proposes a number of factors that influence the occurrence of order effects. One of these is the processing of evidence, whether beliefs are revised once after all the evidence has been processed, in an end-of-sequence manner, or whether belief-revision occurs after each individual piece of evidence, in a step-by-step manner. The following sections describe how the response mode impacts on order effects.

<u>Mode of Responding: Response mode asked for (end-of-sequence or step-by-step response)</u>

A key postulate of Hogarth and Einhorn's (1992) belief-adjustment model is that the occurrence of order effects will be influenced by the mode of response that the observer is asked to make. Hogarth and Einhorn propose that 2 basic modes of response are end-of-sequence (EoS) responses and step-by-step (SbS) responses. In the end-of-sequence (EoS) response mode, observers are asked to make one final judgment after all the information has been presented. Alternatively, in the step-by-step (SbS) mode, observers are required to revise their beliefs after each piece of information, thus updating their judgments in light of new evidence.

Hogarth and Einhorn (1992) predict primacy effects for EoS judgments. Previous researchers have presented theoretical explanations for primacy effects occurring when EoS judgments are made. Asch (1946) theorised that early information sets up a direction or context to which remaining information is fitted, and thus, the early information has greater weighting and primacy effects occur. Alternatively, Anderson and Hubert (1963) proposed early information has greater weighting as less attention is paid to later information. Anderson and Jacobson (1965) also suggested early information has greater weighting compared to later evidence, as information viewed later is discounted as it fails to match the initial impression developed.

Hogarth and Einhorn's (1992) model provides an alternate, yet compatible, explanation for the occurrence of primacy effects in the EoS condition. Mathematically, when EoS judgments are made, the model can be represented by

$$S_k = S(x_1) + w_k[s(x_2, \ldots\ldots, x_k)/n - R]$$

In this representation of the model, when there is no prior information ($S_{k-1} = 0$), the first piece of evidence ($S(x_1)$) becomes the anchor. Following this, the remaining evidence $(s(x_2, \ldots\ldots, x_k)/n)$ is 'some function, possibly weighted average, of the individual subjective evaluations of items of evidence that follow the anchor' (p.12). Thus, Hogarth and Einhorn's model proposes that initial evidence creates the anchor, which exerts a strong influence on the overall impression. Each subsequent piece of information has an equal effect, as it forms part of an aggregation of all the evidence following the anchor. Consequently, later evidence fails to strongly influence the overall impression compared to the strength of the anchor, and primacy occurs due to the initial piece of information having a greater impact.

In the SbS mode, Hogarth and Einhorn (1992) explain that a new anchor is created by each new piece of information, as SbS processing forces equal attention to be paid to all the information. Thus mathematically, for SbS judgments, the model can be represented by

$$S_k = S_{k-1} + w_k[s(x_k) - R]$$

| Encoding: | Estimation | | Evaluation | | | |
|---|---|---|---|---|---|---|
| Type of Evidence: | All | | Mixed | | Consistent | |
| Response Mode: | EoS | SbS | EoS | SbS | EoS | SbS |
| Short Series | | | | | | |
| Simple | Primacy | Recency | Primacy | Recency | Primacy | No effect |
| Complex | Recency | Recency | Recency | Recency | No-effect | No effect |
| Long Series | Force towards primacy | Force towards primacy | Force towards primacy | Force towards primacy | Primacy | Primacy |

*Table 2.1. Belief-Adjustment Model; Summary of Order-Effect Predictions (Hogarth & Einhorn, 1992)*

In the SbS mode, the process of belief revision is repeated for each piece of new information, and so the anchor ($S_{k-1}$) changes in light of each piece of new evidence. Thus, when evaluating later pieces of evidence, beliefs are adjusted against an anchor created by all of the previous pieces of evidence. Consequently, later information has a greater impact on overall assessments, and thus recency effects are predicted when SbS judgments are required.

Mode of Processing: How information is processed (EoS or SbS processing).

A feature of the belief-adjustment model is the distinction between the response mode asked for, and the actual mode of processing used. As stated by Hogarth and Einhorn (1992), 'It would be convenient to assume that people always use an SbS process when faced with an SbS response mode, and an EoS process when faced with an EoS response mode'. (p. 12). However, Hogarth and Einhorn recognise this is not the case, as when an EoS response is asked for, information might still be processed using an EoS or an SbS strategy. Therefore, the primary postulate of Hogarth and Einhorn's belief-adjustment model is the actual mode of information processing used.

In proposing their model, Hogarth and Einhorn evaluated 76 experiments (see Table 2.2) and found that in the 54 studies that participants made EoS judgments, 36 revealed primacy effects. In the 22 studies that asked for SbS judgments, 20 found a recency effect. This offered an empirical basis for the model's predictions of primacy in the EoS condition, and recency in the SbS condition. For example, in Asch's (1946) study, EoS judgments were asked for when assessing the target person, and primacy effects were found. Furthermore, when Stewart (1965) asked participants to form impressions from lists of adjectives presented in different orders, primacy effects were found when just one rating was made after all adjectives had been presented (EoS mode). However, Stewart found a recency effect when participants made ratings after each individual adjective was presented (SbS mode).

In a more recent study that tested the predictions of Hogarth and Einhorn's (1992) model, Kerstholt and Jackson (1998) examined the influence of response mode through exploring judgments of guilt in criminal trials. Kerstholt and Jackson manipulated the order of defence and prosecution evidence (descriptive information),

| Evidence Items | Simple | | Complex | | |
|---|---|---|---|---|---|
| Response Mode | EoS | SbS | EoS | SbS | Total |
| | | Short series | | | |
| Primacy | 19 | - | 1 | - | 20 |
| Recency | 5 | 16 | 7 | 2 | 30 |
| No Effect | 3 | - | 1 | - | 4 |
| | | Long series | | | |
| Primacy | 12 | 2 | 2 | - | 16 |
| Recency | 2 | - | 1 | 2 | 5 |
| No effect | - | - | 1 | - | 1 |
| Total | 41 | 18 | 13 | 4 | 76 |

(Reproduced from Hogarth & Einhorn, 1992)

*Table 2.2. Classification of results of order effects studies according to task characteristics*

and asked participants to judge the defendant's probability of guilt either after each witness statement (SbS mode) or after having read all witness statements (EoS mode). As predicted by Hogarth and Einhorn's (1992) model, recency effects were found in the SbS condition, and primacy effects were found when EoS judgments were made. Kerstholt and Jackson concurred with the belief adjustment model, suggesting that in SbS conditions, when new pieces of evidence are compared to an overall judgment of previous information, more weight is given to the latest evidence.

Hogarth and Einhorn (1992) distinguish between the response mode asked for, and the actual mode of processing used. When participants are asked for an SbS response, they can't use an EoS strategy, thus SbS processing must be used. In contrast, if asked for an EoS response, participants can use either EoS or SbS processing. From Table 2.2, 34 out of 54 studies asking for EoS responses were seen to result in primacy effects. However, 15 studies asking for EoS responses found recency effects. Hogarth and Einhorn (1992) proposed that EoS studies resulting in recency were most likely due to participants adopting an SbS mode of processing, even when asked for EoS judgments were asked for.

Hogarth and Einhorn suggested that when participants are faced with a series of information to process, the key to which processing strategy used depends on the cognitive demands the information being assessed places on participants. Aggregating information using an EoS strategy might place a high demand on mental resources, while step-by-step integration of items of information using an SbS strategy gives participants a strategy to deal with the demands of processing information. Therefore, the choice of which processing strategy to use is determined by the effects of task characteristics on cognitive capacity. These characteristics include the length of information series, and the complexity of information, which are further factors in Hogarth and Einhorn's model which will be examined in the following sections.

A participant's motivation to actively process information to reach an accurate judgment, and their capability to process information might determine which mode of processing is used (Hogarth & Einhorn, 1992). The Elaboration Likelihood Model (ELM: Petty & Cacioppo, 1986) explains how external or internal variables might impact on judgments made. Petty and Wegener (1999) suggest that the most critical construct in the ELM is the elaboration continuum, which is defined by how motivated and able people are to assess the merits of evidence presented to them. The more motivated and able people are, the more likely they are to effortfully scrutinize all available relevant information. Therefore, if people are highly motivated to think, they are likely to assess information much more thoroughly, and arrive at a more reasoned and thorough judgment. Alternatively, with low motivation to think, there is a reduction in information scrutiny, with people looking for a simple and quick way to make judgments rather than examining all of the information carefully. Thus, with less scrutiny of all the information, people might base their judgment on the first information processed, the number of arguments presented, or even on a brief analysis of the target (e.g. does he/she seem attractive, likable?). Consequently, with less motivation to think, it appears more likely that people will adopt an EoS manner of processing, making a single judgment, which is predicted to result in primacy effects. Alternatively, when motivated and able to engage in greater scrutiny, it is more likely that initial impressions can be modified. Thus, a high level of motivation to think is likely to replicate an SbS processing strategy, even if an EoS response is asked for. This greater motivation to process information would offer one explanation for why recency effects might occur in the EoS condition.

In order to measure an individual's level of motivation to think, an assessment instrument was developed (Cacioppo & Petty, 1982; Cacioppo, Petty, & Kao, 1984), with a pool of statements generated concerning a person's reactions to engaging in effortful thinking in a variety of situations. From this, the Need for Cognition Scale (NCS) was designed to distinguish those individuals who tend to engage in effortful thinking from those who do not. Ahlering and Parker (1989) investigated order effects in an impression formation task, and used the NCS to classify levels of motivation to think. Participants were given eight positive and eight negatives trait adjectives to describe a target person, with the positive adjectives either preceding or following the negative adjectives. The results showed people low in need for cognition displayed primacy effects in their judgments of the target, while these primacy effects were offset for the high need for cognition group. Ahlering and Parker proposed that people with low motivation to think formed impressions early and then ceased paying attention to remaining evidence. However, more highly motivated thinkers were thought to pay greater attention to all relevant information. This is in line with Hogarth and Einhorn's theorising, that higher motivation to think would mean the use of an SbS style of processing, with judgments updated in light of each new piece of information, and this would explain the absence of primacy effects.

Other research in the impression formation literature has supported these findings using alternate classifications of the extent of an individual's thinking. Richter and Kruglanski (1996) proposed that if cognitive capacity is limited, a person is likely to freeze on their current judgments, and then they fail to modify these judgments in light of new information. This need for cognitive closure has resulted in greater primacy effects in impression formation tasks (e.g. Kruglanski & Freund, 1983; Heaton & Kruglanski, 1991). Kruglanski and Freund (1983) linked this theorising with Anderson and Jacobson's (1965) discounting theory, as inconsistent later information is denied (or discounted) as it is not compatible with the early impression developed. Furthermore, Richter and Kruglanski suggest the need for closure notion is compatible with the attention-decrement hypothesis (Anderson & Hubert, 1963), as less attention is paid to new evidence once closure has been attained.

Another factor that might affect the processing strategy used is the level of accountability participants have for making accurate judgments, with greater accountability likely to increase active processing of all information in a SbS manner. Tetlock (1983) studied pro and anti-defendant information provided in criminal trials, and found primacy effects in judgments of guilt, but only when participants didn't expect to provide justifications for their decisions. In addition, Cushing and Ahlawat (1996) asked participants to provide a rationale for their audit decisions and found order effects to be offset. Cushing and Ahlawat proposed that through the greater involvement from making the auditors accountable for their judgments, they paid more attention to all the evidence. This resulted in an absence of order effects that biased overall judgments. In their study examining order effects in personnel decision-making, Highhouse and Gallo (1997) proposed the greatest limitation of their study was the lack of incentives for participants to provide accurate ratings, and suggested that order effects might have occurred due to participants having little motivation to consider all the evidence. In view of this, greater accountability is likely to make individuals pay closer attention to all information in striving to make an accurate judgment, which is similar to an SbS processing strategy.

Hogarth and Einhorn (1992) also suggested some EoS studies resulting in recency involved experimental manipulations that probably impacted on the judgment process. Such manipulations might have meant SbS processing was used, even though EoS responses were asked for. Providing instructions warning against the influence of first impressions may be such a manipulation that reduces primacy effects, as Luchins (1957) found when warning participants against making snap judgments. Instead, participants were told to suspend their judgments until they had received all the information about the target person. The results showed this advanced warning weakened the primacy effects found in Luchins' earlier studies when using the same stimuli. Greenlees and colleagues (2008) also found that warning coaches about the primacy bias eliminated primacy effects in the EoS condition. Intuitively, warning participants against making an early impression would reduce the strength of order effects occurring, as individuals might be more likely to correct for a judgmental bias if they are aware of it and are motivated to correct it (Wegener & Petty, 1995). Thus, participants would be more likely to pay attention to all evidence, thus updating their judgments regularly in a SbS style of processing.

Research has therefore shown that making participants accountable for their decisions, and warning against being overly influenced by early information might impact on order effects as each manipulation can be conceptually linked with producing an SbS processing strategy. In contrast, fatigue is a variable that could create a move away from effortful processing, and back towards EoS processing. Webster, Richter and Kruglanski (1996) found that students who had just sat an examination and were mentally fatigued showed greater primacy effects than non-fatigued students in forming impressions of a job applicant. When fatigued, participants are unlikely to pay equal attention to each piece of information, as they don't have the cognitive resources available to fully process to all the evidence and continually update their judgments. Thus, when fatigued, a move away from recency and towards primacy would result. It is likely that emotional responses such as a person's mood or level of tiredness could reduce the level of processing (Webster et al., 1996). In this situation, people are looking for a simple, quick, and easy way to form an impression, as they have less cognitive resources available to process all the information. Thus, they are more likely to make one judgment, thus replicating the EoS condition in Hogarth and Einhorn's model.

Length of the Sequence of Evidence (short or long series)

The length of the series of evidence is a further factor that Hogarth and Einhorn (1992) propose will influence the occurrence of order effects, with primacy effects predicted for long series of information. Hogarth and Einhorn categorized order effects studies into short series (between 2-12 pieces) and long series (17 items or more) of evidence. Their classification was due purely to the studies falling conveniently into these two categories. Hogarth and Einhorn argued that primacy effects are predicted for long sequences as more information is processed across time. In such cases, people become less sensitive to incoming information, as this represents an increasingly small proportion of the evidence already processed. Furthermore, Hogarth and Einhorn suggested that participants could tire if asked to process many pieces of information in the EoS response mode. This theorising can be conceptually linked to Anderson and Hubert's (1963) theory of attention decrement, with a reduction in attention resulting in a lack of motivation to actively process later information. Consequently, an SbS processing strategy is unlikely for long series of information, unless specifically asked for. An alternative explanation is that for a long sequence of information, and when only one judgment is made (EoS response), participants reach a decision they are confident in, and discount further information that doesn't fit in with their initial impression (Anderson & Jacobson, 1965).

Curley, Young, Kingry, and Yates (1988) presented medical and nursing students with a 'long' series of 28 slides, each with a specific clinical symptom and disease. At the end of the sequence, participants estimated the strength of the relationship between the symptom and the disease. As Hogarth and Einhorn's model predicts, Curley et al. found information earlier in the sequence was more influential, and primacy effects were displayed for this long series of information.

Lichtenstein and Srull (1987) provided one of only two studies that Hogarth and Einhorn identified that found recency for a long series of simple items. In their study, participants were asked to make judgments about the likeability of a stimulus person after reading a series of behaviour statements. Half the participants received the majority of favourable statements at the beginning of the list and the other half received the majority of unfavourable statements at the beginning. The groups were further divided, with half asked to recall as much information as possible before making their judgments, and the other half completing these two measures in the reverse order. As predicted by Hogarth and Einhorn's model, primacy effects were found for a long series when no recall was needed. However, when participants had to recall evidence items for comprehension, recency effects were found. Lichtenstein and Srull suggested that conditions encouraging additional processing would offset the judgment biases causing primacy effects, even for long series of information.

The findings of Lichtenstein and Srull (1987) suggested that having to recall evidence created a move away from primacy and towards recency. Indeed, Anderson and Hubert (1963) found that when participants were expected to recall all adjectives describing a target person, primacy effects were eliminated or recency took its place. Anderson and Hubert theorised that expecting to have to recall all the adjectives would force participants to pay attention to all the adjectives in the sequence, thus increasing their motivation to attend to all the information. In Curley et al.'s (1988) study, when participants were warned they would be expected to recall evidence presented to them, this reduced the primacy effects in the medical judgments made. In line with the theorising of Petty and Wegener (1999), being asked to recall information would increase motivation to think, thus creating more active processing of all information. Consequently, asking for recall of evidence would indicate that even in the EoS response mode, an SbS strategy is utilised, due to the more active processing of information. Therefore, the influence of early information is reduced, as greater attention is paid to all evidence, and a move away from primacy and towards recency is the result.

One criticism of Hogarth and Einhorn's (1992) model concerns the classification of a long or short series of information. They categorised a short series of information as 2-12 items, and more than 17 was classified as a long series. Greenlees et al. (2007) suggested this was based on an arbitrary split of the research studies conducted at the time of their investigation, rather than on any theoretical standpoint. Furthermore, Newtson (1973) proposed that individuals control information by splitting incoming evidence into finer units of information. For example, Newtson and Rindner (1979) slowed down the speed of footage shown or asked participants to focus on smaller units to split information provided into smaller units. This could produce a longer series of information, and primacy effects were seen to emerge. Thus, these results were in line with primacy effects predicted by Hogarth and Einhorn's model for long series of information. Greenlees and his colleagues found primacy effects in a short (8 items) series of evidence. However, in light of Newtson and Rindner's theorising, Greenlees et al. postulated that each item of skill could be broken down into 3 subcomponents. Therefore, the sequence length would be 24 items. Thus, the 'long' series could account for the primacy effect. If this was the case, Greenlees et al. suggested that more research is needed to 'refine the notion of sequence length' (p.487).

Complexity of Information (simple or complex)

Table 2.2 shows that when information is simple, particularly for long series of information, primacy effects are more likely. In contrast, studies using complex information have found recency to be a more consistent finding. Thus, the complexity of information is a further variable that Hogarth and Einhorn (1992) identified as an influence on order effects. Hogarth and Einhorn defined complexity as a function of the amount of information processed and the perceiver's familiarity with this information. Simple tasks were categorised as ones familiar to participants, or which require them to process only a single item for each piece of evidence. Complex information was defined as unfamiliar information or a large amount of information contained in a single piece of evidence. Hogarth and Einhorn proposed that as complexity of evidence becomes greater, an increase occurs in the information-processing demands placed on participants. In this situation, aggregating all the information and integrating this with the initial anchor can take up a large amount of mental resources. Consequently, even when EoS responses are asked for, people are likely to be forced into using an SbS strategy after encountering new pieces of complex evidence, in order to cope with the cognitive demands of the task. The use of SbS processing would explain why complex information would result in recency effects, even in the EoS condition.

In evaluating the 76 experiments, Hogarth and Einhorn (1992) found that for evidence categorized as simple, 31 out of 40 studies using the EoS response mode found primacy effects, and 18 out of 18 studies in the SbS mode revealed recency effects. In comparison, for evidence classified as complex, 11 of 15 studies showed recency effects regardless of judgment condition. Thus, Hogarth and Einhorn proposed that for simple evidence, primacy is predicted in the EoS condition, and recency is predicted in the SbS condition. However, for complex evidence, recency is predicted in both judgment conditions. In light of this, it is likely complexity is a further factor that will result in an SbS strategy being used, even when an EoS response is asked for, in order to deal with the demands of processing complex information.

A number of applied studies across a variety of domains have supported predictions of the belief-adjustment model concerning complexity of information. Early order effects research (e.g. Asch, 1946; Anderson & Barrios, 1961; Anderson, 1965) found primacy effects when using simple series of adjectives. In a study exploring order effects in personnel decision-making, Highhouse and Gallo (1997) asked participants to view a candidate's performance in two role-play exercises, and made ratings either in the EoS or SbS mode. The results showed evidence of a recency effect regardless of the response mode. Highhouse and Gallo argued that this was because the information presented was complex. Therefore, even in the EoS condition, it was likely that SbS processing was used to cope with the cognitive demands of processing such complex information. Thus, these results were consistent with Hogarth and Einhorn's (1992) model.

Complexity is also proposed to be a function of judgers' experience levels. Expertise in a specific domain is likely to provide a person with strategies to cope more effectively with greater amounts of information (Newell & Simon, 1972), as greater experience results in evidence being more familiar to participants. In this instance, less cognitive resources are needed to process the information. In contrast, inexperienced participants find information unfamiliar and therefore more complex (Hogarth & Einhorn, 1992). Consequently, less experienced people are likely to use SbS processing to cope with increased cognitive demands created by complex evidence, even when an EoS response is asked for. Thus, Hogarth and Einhorn's belief adjustment model predicts recency for inexperienced participants.

Researchers have operationalised complexity in terms of familiarity. Adelman, Tolcott, and Bresnick (1993) used trained Army air defence personnel as participants to investigate how incoming information would lead to the perception of an aircraft being friendly or hostile. The findings revealed recency effects, and furthermore, enlisted personnel showed larger recency effects compared to officers in the SbS mode. Aldeman et al. hypothesised that the lesser experience of the enlisted personnel meant they perceived evidence as complex, compared to the officers. Thus, greater complexity resulted in SbS processing and recency effects. Similar results have been shown in auditing judgments. Kennedy (1993) found less experienced participants were more susceptible to recency effects, and Messier and Tubbs' (1994) also found recency effects in the judgments of less experienced auditors.

Evidence has been presented to support Hogarth and Einhorn's (1992) model with regards to the complexity of information. However, there is uncertainty regarding whether items of information should be defined as simple or complex. Moreover, when reviewing order effects research, Hogarth and Einhorn acknowledged the difficulties they had in distinguishing whether information was simple or complex. For example, evidence items from Dreben et al.'s (1979) juror study were classified as simple because 'subjects were only given 10 seconds to read the words and provide ratings' (p.6). This definition of whether an item is simple or complex can be seen as arbitrary. Furthermore, Cortez and Walkyria (2005) criticised the model in view of this, suggesting that defining the level of complexity is very subjective in nature. In addition, Cortez and Walkyria pointed to the definition for complexity being confounded with length, and length categorization is constrained by the number of items. Furthermore that the term 'item' is not operationalised, as it could be a word, a number, or a sentence.

Type of judgment made (evaluation vs. estimation: mixed vs. consistent).

Hogarth and Einhorn (1992) further considered the way judgments are made, by distinguishing between evaluation tasks and estimation tasks. In evaluation tasks, individuals encode evidence as positive or negative with respect to the hypothesis under consideration. For example this might involve a true or false response, or in sport, to select or leave out a player in a team. In contrast, in estimation tasks, evidence is relative to the current level of belief. In sport, an estimation task might refer to the extent to which a player has ability. The belief-adjustment model also predicts that order effects depend on whether the evidence sequence is consistent (all positive or all negative evidence) or mixed (mixed positive and negative evidence). Hogarth and Einhorn's model predicts an interaction between whether the task involves evaluation or estimation, and whether evidence is consistent or inconsistent. More specifically, the model predicts that in evaluation tasks, consistent evidence produces no order effects; whereas inconsistent (positive and negative) evidence produces recency effect due to the increased weighting of evidence coming second in a sequence rather than first.

These predictions of Hogarth and Einhorn's (1992) model have been supported in the social psychology literature. For example, Ashton and Ashton (1988) carried out a series of four experiments to test for order effects for consistent or mixed evidence. They presented four pieces of evidence and asked accountants and auditing students to perform judgment updating tasks in an auditing context, using SbS methods to process information. As predicted, for mixed evidence, a recency effect was observed with later evidence having a greater influence on the final judgments. In these studies, no order effects were found when the evidence was consistently positive or negative. Ashton and Ashton suggested that their findings should be tested in more realistic audit contexts, as they used a simplified, well-defined setting. A subsequent investigation by Tubbs, Messier, and Knechel (1990) extended this work in more realistic audit contexts, using more content-rich audit scenarios. Tubbs et al. found recency effects for mixed evidence, but not for consistent evidence. These findings offer further support for Ashton and Ashton's results, and for the predictions of the belief-adjustment model.

After detailing the predictions of their belief-adjustment model, Hogarth and Einhorn (1992) carried out a series of studies themselves to examine and validate the model's predictions. The purpose of these studies was specifically to examine differences for consistent and mixed information, when evaluations or estimations are made. In these studies, participants watched footage from four scenarios. For example, one scenario concerned a target baseball player, whose form had sharply improved after a coaching program. The findings were fully consistent with the predictions the model makes about no order effects for consistent evidence, recency for mixed evidence (across both EoS and SbS response modes), and recency in consistent evidence for estimation but not evaluation tasks. Hogarth and Einhorn concluded that their results offered support for the predictions of their belief-adjustment model.

Limitations and criticisms of Hogarth and Einhorns' (1992) model

While their framework has shown how task variables and processes interact to produce order effects in belief updating, Hogarth and Einhorn (1992) acknowledged that further research should explore how other procedural and task variables affect this process. Hogarth and Einhorn pointed to variables such as time pressure, expertise, and temporal delays, and proposed it would be worthwhile to investigate the influence of these variables on order effects. In addition, Hogarth and Einhorn suggested how factors such as physical appearance (Benassi, 1982) may influence order effects by interacting with various task characteristics. Hogarth and Einhorn acknowledged their belief-adjustment model fails to account for such variables. In addition, variables such as recall of information, fatigue, background information, and accountability might be considered in view of how they might influence order effects.

A further limitation of the belief-adjustment model is that it makes no allowance for personality differences of participants making judgments. The model fails to recognise that participants might have different traits that influence their final judgments, and how these traits might make them more or less susceptible to order effects. For example, Hogarth and Einhorn (1992) suggested people might have different levels of sensitivity toward negative and positive evidence. Furthermore, Wang (1998) criticised the model on the grounds that some people might weight positive and negative information differently. Consequently, this is an individual difference that could influence order effects but is not accounted for in Hogarth and Einhorn's model. Indeed, in his original studies, Asch (1946) reflected on his own failure to deal with the role of individual differences, and how participants' own personal qualities might influence impressions formed. Furthermore, Luchins (1957) postulated: 'One wonders what kind of individual differences played a role in determining why one subject consistently showed primacy effects, another showed recency effects, and yet another did not show either of these responses consistently' (p.57). Luchins identified some potential individual differences, for example closure, and tendencies towards "Pragnanz" (making a regular, stable impression and working against irregularities or inconsistencies). Further research is needed to examine the impact of individual differences on the incidence of order effects.

The role of individual differences in order effects

Asch (1946) acknowledged the role of individual differences was not investigated in his research and questioned whether participants' own personal qualities might impact on their impressions formed of others. Asch suggested that when a theoretical clarification has been reached, a proper study of individual differences could be pursued. Hogarth and Einhorn (1992) have formulated a theoretical belief-adjustment model to predict conditions in which order effects may occur. However, in their belief adjustment model, Hogarth and Einhorn failed to fully acknowledge how personality traits of the person making judgments might influence order effects.

A person's motivation to think (e.g., Cacioppo & Petty, 1982) and scrutinise all information carefully is one such individual difference that might influence the incidence of order effects. Similarly, a person's need for cognitive closure (e.g., Kruglanski & Freund, 1983) and their tendency to fix on early impressions would be likely to influence order effects. A further personality variable that might impact on order effects concerning judgments of another's ability is a person's beliefs in how ability can be developed. Erdley and Dweck (1993) explored whether those children who believe personality is a fixed quality (entity theorists) would make more long-term social judgments than those who believe personality is malleable (incremental theorists). Participants aged 9 to 11 years, were shown slide shows of a target child displaying negative behaviours. Following this, half the participants were shown negative behaviour consistent with the original evidence, and the other half shown positive behaviour inconsistent with the earlier negative behaviour. Participants rated the target on a range of positive and negative personality traits. The results showed that the children categorised as entity theorists did not differ in their ratings of the target, even when disconfirming positive evidence was viewed second. However, incremental theorists did differ in their ratings in light of the positive evidence. Erdley and Dweck concluded that incremental theorists were more flexible in their judgments. Such flexibility might be linked to a SbS strategy, as both involve greater processing of later evidence to fully update judgments. In contrast, entity theorists were more influenced by early information and thus prone to primacy effects, as they were less likely to revise their judgments in the face of disconfirming evidence.

More recently, in a study exploring impressions of mathematical ability, Butler (2000) presented participants with sets of mathematical scores of a target pupil, with half the participants viewing ascending scores, and the other half viewing a descending trend. Butler gave participants statements such as 'everyone has a certain amount of mathematical ability, and one can't do much to change that', and their level of agreement to these statements determined if they were entity or incremental theorists. The results provided strong support for the proposal that people's theories about the nature of ability moderate the effects of the order of information presented to them on their inferences about the level of that ability. More specifically, entity theorists inferred higher ability about others (and themselves) when performance declined, and incremental theorists inferred higher ability in the event of improving performance. In light of this research and theorising, a person's beliefs about the nature of ability might be a personality trait that influences order effects.

### Summary

Despite these limitations, Hogarth and Einhorn (1992) have produced a model with a sound theoretical underpinning that researchers have used as a focus to explore order effects in a variety of domains (e.g. Trotman & Wright, 2000; Igou & Bless, 2002). In addition, Hogarth and Einhorn's predictions provide a rationale for testable hypotheses that researchers have used in their experiments. Consequently, Hogarth and Einhorn's belief-adjustment model provides the underpinning theory used in the present thesis to investigate order effects.

## ORDER EFFECTS IN ASSESSMENTS OF ABILITY

Since Asch's (1946) series of studies, researchers have explored order effects in different situations and across a variety of domains. However, only a limited number of studies have examined how assessments of ability could be influenced by order effects. Assessments of ability can be defined as a perceiver's cognitive representations of the certain qualities of another, which might allow the perceived individual to perform certain tasks successfully. In a series of experiments, Jones, Rock, Shaver, Goethals, and Ward (1968) found primacy effects when perceivers made ability judgments concerning a target person. Jones et al. asked participants to observe a stimulus person attempting to solve a series of intellectual problems. Participants watched 30 difficult multiple choice questions being attempted by the target person. In the first experiment, participants saw 15 questions out of the 30 being answered correctly. One group observed more questions being solved correctly at the beginning of the test (a descending order that replicated the favourable to unfavourable conditions in Asch's 1946 tests). Another group saw more questions being answered correctly in the latter part of the test. A third group saw the 15 correct answers given in a random order. In the first study, participants also attempted to solve the problems themselves. According to the pre-designed feedback, they were always seen to "solve" 10 problems correctly. Following this procedure, participants were asked to rate the level of intelligence of the target person, and asked to predict the target's success in a follow up test.

The results revealed the target person was perceived to perform better in the descending pattern of success compared to either the ascending or the random success group (primacy effect). More specifically, the participants in the descending condition predicted the stimulus person would solve significantly more problems in the second series compared to participants who viewed the ascending condition. Furthermore, when asked to recall how many correct answers were made in the first series, scores in the descending condition were significantly higher than in the ascending group. Jones and his colleagues (1968) were surprised by these unexpected results. They had initially hypothesized greater ability would be attributed to a performer showing systematic improvement. To explain their findings, Jones et al. suggested that the early success of the target person might have meant participants ceased to make comparisons with the person they were viewing. Thus, participants sought to maintain their self-esteem through viewing the stimulus person as unusually talented. Consequently, participants might have distorted recall scores in the direction of their initial impression.

Jones et al. (1968) acknowledged these speculations were tentative, until the results were replicated under more rigorous conditions. In four follow-up experiments, the target person was videoed to create ascending, descending and random conditions. Jones et al. postulated that the target person might have exhibited non-verbal cues resulting in the participants' ability assessments being unwittingly influenced. With the target person on film, all of their expressions and behaviour were identical in all conditions, with just the order of the successful performance varied. Thus, videoing the target person in action removed any potential sources of judgment bias. When the videotaped footage was used in the second of Jones et al.'s (1968) series of studies, the primacy effects of the initial study were replicated.

Jones and his colleagues (1968) made small alterations to their following two studies. In the third study, some participants were led to believe that results of their performance would be publicised. Jones et al. suggested primacy effects might have been amplified in the declining condition when the results were made public in order to maintain self-esteem (through comparisons with the target's own scores). This variation failed to result in any differences in the strength of the primacy effects. In the fourth study, participants were not asked to solve the problems, and primacy effects were still observed. These findings weakened Jones et al.'s theory that participants attributed higher levels of ability to the target person in order to maintain levels of self-esteem.

The fifth of Jones et al.'s (1968) series of experiments examined whether males and females would produce the same pattern of results. The primacy effects observed meant Jones and his colleagues eliminated gender as a possible influence on order effects. The findings of this fifth study were consistent with the earlier studies, thus, Jones et al. concluded that they were dealing with a robust finding of primacy. Furthermore, they speculated that decisions concerning ability are made quickly, despite often on the basis of inadequate or misleading information. Thus, Jones et al. pointed to information discounting (Anderson & Jacobson, 1965) to explain how once a level of ability is assigned, it is variations in factors such as luck or motivation that account for subsequent variations in performance. Furthermore, Jones and his colleagues suggested it is easier to form an impression than change one, and proposed this may be especially true of stable dispositions like ability. Jones et al. also reflected on the potential applied implications of these results. For example, if a person performs well at first but then their performance level drops, a perceiver might judge their ability overly high. Alternatively, an improving performer might be removed from a team or squad just at the time of improvement, or a 'late blooming' worker or student may not get the recognition his/her ability deserves.

In response to the primacy found in Jones et al.'s (1968) research, Jones and Welsh (1971) suggested that primacy is a limited effect, and in everyday life, recency is the rule. They pointed to the nature of the questions solved in Jones et al.'s (1968) experiments, and proposed that the target person solving the questions either knew the answer, could make educated guesses, or did not know the answer. In these situations, Jones and Welsh proposed that no learning opportunities were provided for the participant. In contrast, games of strategy mean players must be flexible, adapting to the situation, and utilising information gained to develop their methods of play. Thus, if participants believed the target person was learning the skill, and ability levels could be improved, then recency would occur as later information would have more influence. This is in line with Butler's (2000) theorising that incremental theorists will exhibit recency effects. Incremental theorists are proposed to be more flexible in their judgments, as they don't consider early information to be key to overall ability, as they believe ability can be improved.

In Jones and Welsh's (1971) study, two students were seen to play a strategy game, in which student X was seen to be losing steadily in the first third of the game, holding his own in the middle third, and then gaining ground on student Y in the final third to eventually draw even in the game. The performance of student Y was reversed, as he was seen to start well and then decline in performance. The results demonstrated recency effects, with participants in the study judging student X (ascending condition) as being more retentive, successful, and generally smarter than student Y. Theoretically, in line with Butler's (2000) theorising, Jones and Welsh (1971) suggested that recency effects were due to participants observing a learning effect in such games of strategy. Therefore, later evidence had a greater influence on overall impressions of ability.

Since this early work, a number of other researchers have explored order effects in ability assessments, with primacy effects emerging as a consistent finding. Allen and Feldman (1974) conducted their research in an applied setting, exploring the impact of order effects on judgments of academic ability. Tutors viewed students answering mathematical questions, with the performance of the tutee controlled to create different patterns of success and failure in two halves of the task: success-success, failure-failure, success-failure, and failure-success. The results showed a primacy effect, with early performance more strongly influencing the tutor's assessments of ability. Furthermore, the tutor reported perceiving the tutee more as more likeable when they performed well in the first half compared to when he performed poorly. Additional evidence for primacy effects were demonstrated in the success-failure condition, in which most participants perceived the tutee as being successful throughout the session. In contrast, in the failure-success condition, many participants wrongly reported poor performance in the second half of the session. In agreement with Asch's (1946) 'directed attention hypothesis', Allen and Feldman speculated that primacy effects had resulted from later performance being distorted in the direction of the earlier performance.

Newtson and Rindner (1979) also examined order effects in assessments of ability. Their study involved a target person answering a series of intelligence questions. Performance was controlled to allow participants to view the target answering questions correctly in either an ascending or descending success pattern. The target person's ability was judged significantly higher when starting well followed by a decline in performance, compared to when a poor start was made and subsequent improvement was shown. Newtson and Rindner proposed that primacy effects emerged as individuals paid more attention to earlier information (Anderson, 1965), and having reached a point of subjectively sufficient information, they ceased to process further information.

McAndrew (1981) identified that participants in the studies of Jones et al. (1968) and Newtson and Rindner (1979) had a number of cues available when making their judgments of ability. This included the stimulus person's gender, dress, and attractiveness, as well as the specific nature of the problems being attempted. Thus, McAndrew (1981) examined whether primacy effects would still occur if cues about the person and the nature of the test were lacking. Participants were asked to grade 30 responses from a phantom student, either in an ascending or descending pattern of success. Then participants turned the paper over before counting the number of correct answers and were asked to estimate how many questions the student had answered correctly. In addition, participants predicted how many correct answers there would be in the next set of 30 questions, and also gave a rating of the target student's level of intelligence. Results revealed primacy effects, with the target student in the descending pattern of success perceived to have solved more problems correctly in the first series. Furthermore, the student in the descending condition was perceived as more intelligent, and was predicted to perform significantly better in the second series of problems.

Benassi (1982) looked to extend this research by considering the effects of physical attractiveness of a stimulus person, a factor previously shown to influence attributions concerned with ability and performance (e.g., Clifford & Walster, 1973). Benassi replicated the procedure used by Jones et al. (1968), with participants shown 30 multiple-choice questions answered in ascending or descending patterns of success. In addition, Benassi manipulated the physical attractiveness of the stimulus person by attaching photos to booklets containing the answers to the task. Primacy effects emerged in the low physical attractiveness group, with the ability of the descending performance group rated significantly higher than the random or ascending group, when participants viewed the photo of the less attractive target. However, in the high physical attractiveness group, ability was assessed highly regardless of performance.

Schema theory (Fiske & Taylor, 1991) proposes individuals automatically use cues (e.g., physical appearance, clothing) available early on in a social interaction to assign a person to a certain category. In line with schema-theory, it is plausible to suggest that aspects such as the appearance of a target person could result in a particular schema being developed. From Benassi's experiments, the schema developed was that a physically attractive person was considered to be more intelligent and thus able to answer more questions correctly. Relating this to sport, an example could be a tall, muscular target player eliciting a certain schema of a more talented player, which in turn would influence overall impressions. The work of Benassi suggested that a positive schema might produce high ratings of performance regardless of order, but primacy effects would still occur with a less favourable schema.

The research into assessments of ability has found primacy effects to be a consistent finding (e.g. Jones et al., 1968; Allen & Feldman, 1974; McAndrew, 1981). This research offers support for the predictions of Hogarth and Einhorn's (1992) belief-adjustment model. For example, the studies in which primacy emerged all involved assessments of ability made at the end of the sequence (EoS) of information, as predicted by the belief-adjustment model for EoS judgments. However, these studies have focused on the incidence of order effects, and failed to test the predictions of Hogarth and Einhorn's model through a systematic examination of situations in which order effects occur. Therefore, the studies only provide a limited understanding of how order effects might influence assessments of ability. In light of this, it would be premature to say that primacy is a robust finding (e.g. Jones et al., 1968) until other conditions have been explored, especially when different processing strategies are used (EoS and SbS).

Furthermore, the research is limited as it has not explored ability assessments across a variety of domains, for example in sport.

## ORDER EFFECTS IN ASSESSMENTS OF SPORTING ABILITY

In sport, judgments concerning ability and performance are made regularly, with all sporting participants frequently assessed in their career. For example, coaches and managers watch players to inform decisions on who to recruit for squads, or who to select for teams. In some sports, judges assess performance to provide gradings that determine overall finishing positions. It appears very important the ability and performance of a sporting participant is assessed accurately and objectively (Plessner & Haar, 2006). However, until recently, the impact of order effects on judgments of ability in a sporting context had not been explored.

Greenlees et al. (2007) were the first to investigate whether order effects could influence judgments of sporting ability. Greenlees and his colleagues showed participants footage of a target soccer player performing a series of skills. This skill involved the player controlling a pass from a teammate, turning past a marking player, and passing to a second teammate. All participants viewed the same eight video clips, with half viewing a declining (successful to unsuccessful) performance pattern, and half viewing an ascending pattern. Participants made ratings of the target players on five criteria; soccer ability, ball control, speed of thought, attitude and athleticism. Half the participants provided one set of ratings after all clips had been viewed (end-of-sequence condition: EoS) and the other half updated their ratings after viewing each individual clip (step-by-step condition: SbS). Greenlees and his colleagues hypothesised primacy effects when participants made EoS judgments after viewing all the evidence. In contrast, recency effects were hypothesised when participants made SbS judgments. These hypotheses were in line with the predictions of Hogarth and Einhorn's (1992) belief-adjustment model.

In addition, Greenlees et al. (2007) used soccer coaches, players, and non-players for their participant sample. The purpose of this was to explore whether participants' level of experience would influence order effects. In line with predictions of Hogarth and

Einhorn's (1992) belief-adjustment, less experienced participants were expected to view evidence as unfamiliar and thus complex. Consequently, Greenlees et al. hypothesised less experienced participants would show recency effects. However, results of Greenlees et al.'s (2007) study revealed primacy effects regardless of judgment condition and level of participants' experience. These findings are consistent with previous studies of order effects in ability assessments (e.g. Jones et al. 1968), and indicated primacy effects may be a fairly robust finding. In view of the constant findings of primacy, it is also possible that primacy effects are simply inherent in stable attributions such as ability (Jones et al., 1968). In light of their findings, Greenlees et al. postulated that the way athletes' abilities are assessed are biased due to the order of information viewed. More specifically, it was proposed that initial evidence viewed has a greater influence on overall assessments of ability, compared to later evidence.

Unexpectedly, the results of Greenlees et al.'s (2007) study were in contrast to the hypothesised recency effects in SbS conditions. In accord with Hogarth and Einhorn's (1992) belief adjustment model, Greenlees at al. speculated primacy effects may have emerged in the SbS condition due to the length of the information series. Greenlees et al. argued that if participants used finer units of analysis in judging the football skill (i.e. breaking down the skill into 3 smaller units), this could be considered a 'long series' of information. With 8 clips and 3 units of information in each clip, this meant 24 units would need to be processed. This was over the figure of 17 that Hogarth and Einhorn classified as a long series of information. For a long series, Hogarth and Einhorn's model predicts primacy effects, due to people forming impressions after a certain point of a long series, and having sufficient confidence to discount further information. However, this suggestion was tentative and not explored further.

Greenlees et al.'s (2007) study can be criticised with regards to methods used in the SbS condition. More specifically, participants only made one assessment of overall ability after each item of information when making SbS judgments. However, after viewing the final piece of information, participants gave five ratings to assess the target player's ability. In view of this, it was questionable whether participants carried out full SbS processing between viewing each piece of evidence. Greenlees et al. had hypothesised recency effects in the SbS condition, but primacy effects were seen. However, it is possible that the predicted recency effects did not emerge as full SbS judgments were not made. Nevertheless, the results of Greenlees et al.'s study offered evidence that ability assessments might be biased by the order information is presented, although, it is clear that a fuller examination of order effects in sport is needed. Thus, the present programme of research sought to provide such an examination of order effects.

## SUMMARY OF AIMS AND STRUCTURE OF THESIS

The preceding review of the order effects literature has shown order of information viewed can impact on final judgments made, with evidence revealing order effects across a variety of domains. In studies examining ability assessments, primacy effects have been the general finding (Jones et al., 1968; Newtson & Rindner, 1979; McAndrew, 1981; Benassi, 1982). Greenlees and his colleagues (2007) were the first to examine order effects in sport, and their results revealed primacy effects that influenced ability judgments. The aim of this thesis was to build on Greenlees et al.'s study, and provide a more systematic examination of order effects in the sporting domain. The purpose of this thesis was to provide further evidence of order effects as a bias in judgments of sporting ability. In addition, the aim of this thesis was to provide the rationale for applied suggestions to those who make judgments of sporting ability concerning how their judgments might become more accurate in light of this bias. Thus, the following specific aims were generated:

1) To replicate Greenlees et al.'s (2007) study in a different sport (ultimate frisbee), thus investigating the generalisability of Greenlees et al.'s findings.

2) To use an improved method of step-by-step processing to further examine the influence of processing mode on order effects.

3) To investigate whether step-by-step processing offsets primacy, or whether the time delay created by making step-by-step judgments is a confounding variable.

4) To explore personality traits (e.g. entity or incremental theorist, motivation to think) that might moderate order effects.

5) To examine whether participants' level of experience influences order effects.

6) To examine whether participants' accountability for providing accurate judgments influences order effects in the EoS condition.

7) To investigate experimental conditions (e.g. interpolated activities) that might eliminate the primacy bias when end-of-sequence judgments are made.

8) To provide evidence to inform those making ability assessments in sport, as to how primacy effects might best be avoided.

# CHAPTER 3

## STUDY 1: EXAMINING THE INFLUENCE OF RESPONSE MODE ON ASSESSMENTS OF ABILITY.

### INTRODUCTION

Until recently, no research had examined whether order effects influence judgments of ability in sport. Greenlees et al. (2007) sought to address this gap in the sport psychology literature by examining order effects in a sporting environment. Based on the predictions of Hogarth and Einhorn's (1992) belief adjustment model, Greenlees et al. hypothesised order effects would vary according to the type of judgment participants were asked to make. More specifically, primacy effects were predicted in the end-of-sequence (EoS) condition, and recency effects predicted in the step-by-step (SbS) condition. However, Greenlees et al. found primacy effects regardless of judgment condition, with participants' assessments of a target player's soccer ability significantly higher when viewing the declining performance pattern, compared to the ascending pattern. These findings were consistent with previous studies of order effects in assessments of ability (e.g. Newtson & Rindner, 1979; McAndrew, 1981) and supported the suggestion that primacy effects are a fairly robust finding when assessing ability (Jones et al., 1968).

From these findings, Greenlees et al. (2007) postulated that assessments of a player's ability might be biased by the order in which their performances are judged. However, Greenlees and his colleagues acknowledged a limitation of their study was that only one skill (controlling and passing the ball) in a single sport (soccer) was examined. Greenlees et al. pointed to the strength of early research into order effects that used multiple stimulus materials to examine the generalisibility of order effects found. Thus, the first aim of the present study was to investigate whether order effects occurred in another sport. A catching and throwing skill in ultimate frisbee was used, and a target player's performance was rated by ultimate frisbee players. Thus, the study examined whether the order effects found by Greenlees et al. replicated in a different sport setting.

The findings of primacy in Greenlees et al.'s study were in contrast to Hogarth and Einhorn's (1992) predictions of recency in the SbS mode. However, Greenlees et al.'s study can be criticised with regards to the methods used in the SbS condition. Specifically, participants only made one assessment of overall ability after each item of information when making SbS judgments. However, after viewing the final piece of information, participants gave five ratings to assess the ability of the target player. Consequently, it appears the study failed to produce a satisfactory manipulation of the SbS mode, as participants were not asked to engage in full SbS processing between viewing each piece of evidence. Thus, the predicted recency effects might not have emerged as a complete SbS measure was not used. Hogarth and Einhorn suggest an SbS processing strategy means later evidence has more weighting towards the final judgment, and thus recency is predicted. In light of this theorising, the second aim of the present study was to explore the influence of order effects in the SbS judgment mode when more complete SbS processing was required.

A further consideration in the present study was that the delay created by making full step-by-step judgements could be a confounding variable. For example, in Greenlees and colleagues' (2007) study, the non-viewing time between each clip was not controlled. Previous research by Luchins (1957) and Miller and Campbell (1959) revealed that temporal delays between evidence created a move away from primacy and towards recency. Miller and Campbell suggested that time delays create a break between participants accessing evidence. Thus, recency effects would emerge since more recent information would have a stronger presence in short-term memory. In light of this, if recency effects were to emerge in the step-by-step condition, it is possible that the delay created between viewing each clip influenced these findings. Therefore, an additional group was created, in which participants made an end-of-sequence assessment, but a time delay was inserted between clips. This time delay of 12 seconds was equal to the time taken by participants to update their assessments after each clip in the extended step-by-step condition.

In summary, we examined order effects in a sporting environment to explore whether the mode of processing (EoS or SbS) influences the presence of order effects. In addition, the present study examined whether an extended SbS strategy influences order effects. First, in accord with the predictions of Hogarth and Einhorn's (1992) belief-adjustment model, and consistent with previous findings in studies exploring assessments of ability (e.g., Jones et al., 1968; McAndrew, 1981; Greenlees et al., 2007), it was hypothesised that participants in the EoS condition would display primacy effects. Second, it was hypothesised that participants would also display primacy effects when an incomplete method of SbS processing was required. Third, and in line with Hogarth and Einhorn's theorising, participants using a more thorough method of SbS processing were hypothesised to display recency effects. Fourth, in considering the delay condition, the delays in Luchins (1957) and Miller and Campbell's (1959) investigations involved a large break between two blocks of evidence. This was a different type of delay than the short period between each clip created by making SbS assessments in the present study. Thus, it was proposed that in the delay condition, participants would still be processing information using an EoS judgment, and therefore would show primacy effects.

*Hypothesis 1*

In the EoS response condition, primacy effects are predicted.

*Hypothesis 2*

In the SbS (short) response condition, primacy effects are predicted.

*Hypothesis 3*

In the SbS (extended) response condition, recency effects are predicted.

*Hypothesis 4*

In the delay condition, primacy effects are predicted.

## METHOD

### Participants

The participants in this study consisted of 240 club standard ultimate frisbee players (187 male, 53 female), with a mean age of 23.29 years (SD = 4.18 years). Participants' mean playing experience was 4.01 years (SD = 3.46 years). The sample was predominantly white Caucasian ($n = 230$), with the remainder coming from Asian ($n = 7$) and mixed race ($n = 3$) backgrounds. All were volunteers and signed informed consent forms prior to participation. The study was approved by the Ethics Committee at the University of Chichester.

Materials

The stimuli used in this experiment were two DVDs, each comprising footage of two ultimate frisbee players performing a skill eight times. The skill involved the players making a short run to receive the disc, pivoting, and executing a forehand lead pass to a team-mate making a run across the pitch (see Figures 3.1-3.5 for more detail of the skill performed). The footage of the players performing the skills was all filmed at the same venue, using a Panasonic AG-DP800E video camera. The clips were then edited into two DVDs following a similar procedure used by Greenlees et al. (2007).

For the first player shown (i.e. the control player) the eight examples of the skill were randomly selected from a database of 22 examples. For the second player (i.e. the target player) the eight examples of performance were selected from a database of 24 examples. Following the filming, these 24 examples were rated by eight experienced ultimate frisbee players and coaches (mean age = 26.87 years, SD = 3.27; mean playing experience = 7.63 years, SD = 1.77 years) who had each played for their club's first team in the UK national finals, and who each had a minimum of 2 years coaching experience (mean coaching experience = 4.50 years, SD = 1.23 years). There was no control for order, with the coaches rating the 24 clips in the chronological order they were filmed in. The examples were rated on a scale of 1 = very poor execution of the skill to 10 = excellent execution of the skill. The three highest, lowest, and median rated examples were identified respectively. A one-way ANOVA was conducted on these nine ratings, and revealed a significant main effect of the video footage ($F_{7,49} = 51.08$, $p < .01$). Follow up Bonferroni post hoc tests revealed that the three 'good' performances were significantly more positively rated than the three 'moderate' performances and the three 'poor' performances. Additionally, the 'poor' performances were rated significantly more negatively than two of the 'moderate' performances. On the basis of this finding, the footage of the 'moderate' performance that was not rated significantly differently to the three 'poor' performances was removed from the stimulus materials used in the actual experiment. Thus, the stimulus materials consisted of eight examples of the skill. These eight clips were edited into two DVDs, each with a different order of presentation. The first DVD consisted of the three good clips, followed by the two moderate and then the three poor clips. In the second DVD, this order was reversed.

Figures 3.1 – 3.5. Sequences of Ultimate Frisbee Skill Used in the Study

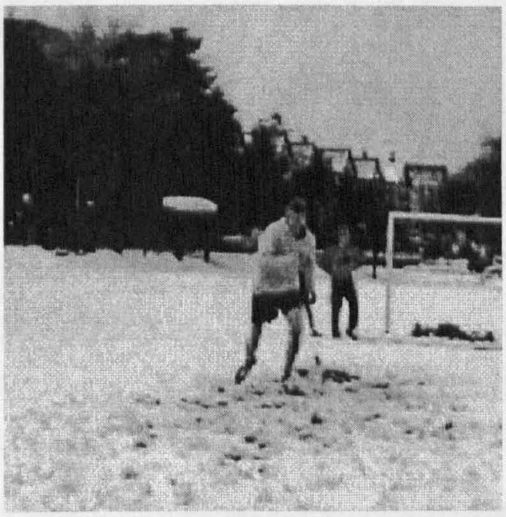


Figure 3.1. The ultimate frisbee player runs directly in line towards the disc being thrown to him.

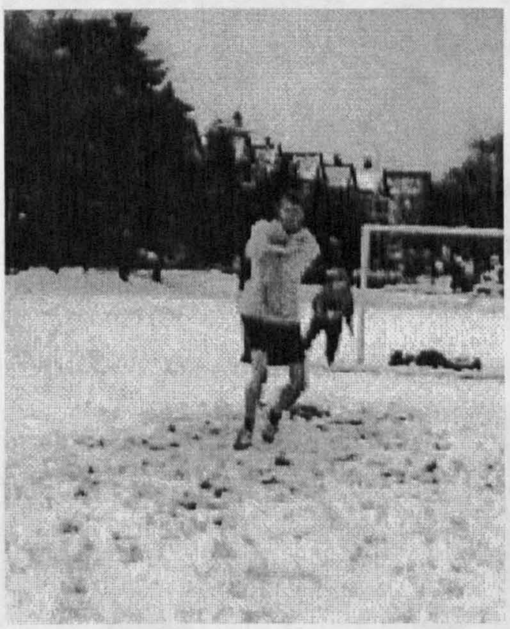


Figure 3.2. He catches the disc.

Figure 3.3. He turns in preparation to make a pass.

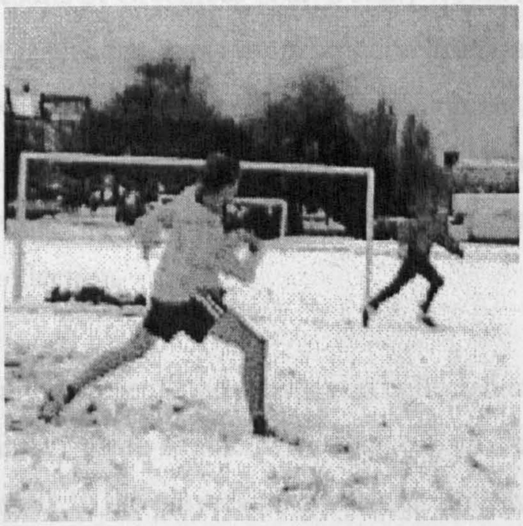


Figure 3.4. He pivots in readiness to make a forehand pass.

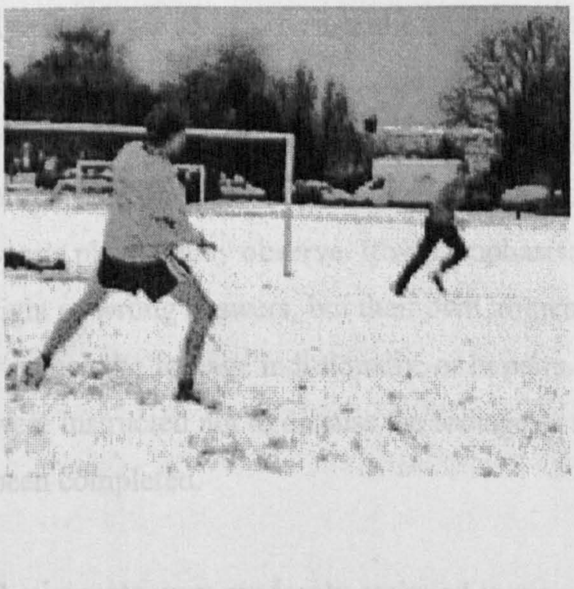


Figure 3.5. He makes a forehand pass, looking to time the pass correctly to meet the run of the receiver.

Measures

*Ratings of the player's ability.* To examine their impressions of the two players observed, participants were asked to rate each player on five factors. These were ultimate frisbee ability (general), disc control, speed of thought, attitude and athleticism. These factors were adapted from those used in Greenlees et al.'s (2007) study. Each aspect was measured on a 10 point, likert-type scale (e.g., 1 = poor to 10 = excellent).

Procedure

Participants were recruited at National Ultimate Frisbee tournaments. Ultimate Frisbee was used as a focus for data collection as it was a different team sport from the Greenlees et al. (2007) study, and thus, the present study would examine whether the results of Greenlees et al.'s study would replicate in a different sport. Ultimate Frisbee was also the focus for practical reasons, as the author had many contacts in the sport, which provided access to a large number of participants (across the programme of studies in the present thesis). Furthermore, the nature of Ultimate Frisbee tournaments, which are usually held over a full weekend, provided suitable opportunities for data collection.

In the present study, data was collected at five different weekend competitions. The author made contact with team captains to outline the study, and to request permission to speak to the players in their team. Following this, the author spoke to players to request their participation in the study. If they were willing to participate, a convenient time was agreed for players to come and complete the ratings task during a break in their competition schedule. A table and chairs were set up in a quiet part of each competition venue, with a laptop set up to show the footage. Participants were informed that the purpose of watching the video footage was to examine how people make judgments of sports players they observe. It was emphasised to each participant that there were no right or wrong answers, but their own impressions that mattered. Participants either watched the footage individually, or in pairs. If footage was viewed in pairs, participants were instructed not to discuss the footage or any aspect of the study until all ratings had been completed.

Participants were randomly assigned to view either the declining pattern of success (starting with the good clips, and finishing with the poor clips), or the ascending pattern of success (same clips as the declining pattern but with the order reversed). In addition, participants were randomly assigned to one of three groups. Those in the EoS condition completed the five ratings after viewing the full sequence of eight clips for each of the two players (target and control player). Participants in the first SbS condition, a condition that replicated the SbS processing in Greenlees et al.'s (2007) study, made a single judgment of overall ability after each clip, and then rated the players on all five criteria after having viewed the last clip. The data points for this condition were collected approximately 12 months after the data points for the other three conditions. Participants in the second (extended) SbS condition completed the five ratings after viewing each individual clip, thus making 8 sets of ratings. In this condition, the researcher manually paused the DVD to allow participants time to complete their ratings. Although ratings were made eight times in each SbS condition, only the final sets of ratings were used in the analyses. A fourth group of participants were assigned to the delay condition. Pilot testing using the stimuli revealed that participants took approximately 12 s to make the ratings after each clip in the step-by-step condition. Therefore, participants in the delay group viewed footage of the control and target players that had a gap of 12 s inserted between each individual clip in both series. As in the end-of-sequence condition, participants in the delay condition completed one set of ratings after viewing all the clips for each of the two players.

Data Analysis

Means, standard deviations, and Pearson correlations for the ratings of the control player and target player are presented in Table 3.1. Pearson product-moment correlations were conducted on the dependent variables to assess the data for multi-collinearity. In Greenlees et al.'s study of order effects, the five dependent variables were combined into one MANOVA analysis. However, Tabacknick and Fidell (1996) state that if you put highly correlated variables into a MANOVA, you will hide possible effects, because you are effectively measuring the same thing. In accord with the guidelines of Tabacknick and Fidell, any correlations of .70 and higher were deemed to indicate that the dependent variables were measuring the same construct. The Pearson correlations (shown in Table 3.1) indicated that for the target player, the correlation between ultimate ability and disc control (.74), and the correlation between ultimate ability and speed of thought (.72) exceeded Tabacknick and Fidell's (1996) criterion value of .70. The correlation between disc control and speed of thought (.68) was

| Variable | M | SD | Subscale 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|---|
| Control ratings ($n = 240$) | | | | | | | |
| 1. Ultimate Frisbee Ability | 6.45 | 1.08 | - | .62(**) | .67(**) | .60(**) | .47(**) |
| 2. Athleticism | 6.34 | 1.20 | | - | .44(**) | .42(**) | .53(**) |
| 3. Disc Control | 6.42 | 1.13 | | | - | .56(**) | .30(**) |
| 4. Speed of Thought | 6.37 | 1.25 | | | | - | .47(**) |
| 5. Attitude | 6.60 | 1.29 | | | | | - |
| Target ratings ($n = 240$) | | | | | | | |
| 1. Ultimate Frisbee Ability | 5.16 | 1.40 | - | .71(**) | .78(**) | .72(**) | .50(**) |
| 2. Athleticism | 4.68 | 1.43 | | - | .50(**) | .58(**) | .48(**) |
| 3. Disc Control | 5.23 | 1.49 | | | - | .69(**) | .30(**) |
| 4. Speed of Thought | 5.18 | 1.44 | | | | - | .47(**) |
| 5. Attitude | 5.65 | 1.52 | | | | | - |

**p<.01

*Table 3.1. Rating means, standard deviations, and intercorrelations between subscales*

| Order of Information | Judgment Group | Combined Construct | | Athleticism | | Attitude | |
|---|---|---|---|---|---|---|---|
| | | Mean | SD | Mean | SD | Mean | SD |
| Declining order | End-of-Sequence | 5.89 | 1.04 | 4.63 | 1.35 | 5.87 | 1.41 |
| | Step-by-step (short) | 5.50 | 1.31 | 4.70 | 1.75 | 5.73 | 1.48 |
| | Step-by-step (extended) | 4.81 | 1.51 | 4.37 | 1.45 | 4.87 | 1.45 |
| | Delay | 5.66 | 1.13 | 5.03 | 1.33 | 5.77 | 1.52 |
| | Total | 5.43 | 1.31 | 4.68 | 1.48 | 5.55 | 1.51 |
| Ascending Order | End-of-sequence | 4.98 | 1.06 | 4.60 | 0.97 | 5.67 | 1.24 |
| | Step-by Step (short) | 4.94 | 1.19 | 4.70 | 1.70 | 5.80 | 1.54 |
| | Step-by-step (extended) | 5.17 | 1.45 | 4.77 | 1.48 | 5.53 | 1.74 |
| | Delay | 4.67 | 1.29 | 4.67 | 1.37 | 5.97 | 1.63 |
| | Total | 4.94 | 1.25 | 4.68 | 1.39 | 5.74 | 1.54 |
| Total | End-of-sequence | 5.43 | 1.14 | 4.62 | 1.17 | 5.77 | 1.32 |
| | Step-by-step (short) | 5.17 | 1.26 | 4.70 | 1.71 | 5.77 | 5.77 |
| | Step-by-step (extended) | 4.99 | 1.48 | 4.57 | 1.47 | 5.20 | 1.62 |
| | Delay | 5.16 | 1.30 | 4.85 | 1.35 | 5.87 | 1.57 |
| | Total | 5.19 | 1.30 | 4.68 | 1.43 | 5.65 | 1.52 |

*Table 3.2. Means and standard deviations for the target player for the three dependent variables in the different subgroups.*

approaching this .70 level. In light of these high correlations, it was decided to combine these three dependent variables (ultimate ability, disc control, speed of thought) into one construct. The scores of the ultimate ability, disc control, and speed of thought were averaged to give a single rating for this combined construct, which formed one independent variable, which was analysed in one ANCOVA rather than a MANCOVA. A further justification for combining these variables, is that a number of separate univariate tests might be misleading, especially with correlated variables, as one rating is being measured repeatedly (Tabacknick & Fidell). This serves as a 'protection against inflated Type 1 errors due to multiple tests of (likely) correlated DVs' (p.376). Thus, for data analysis, the combined construct, athleticism and attitude were the three dependent variables.

To test the hypotheses, a 2 x 4 (order x judgment condition) analysis of covariance (ANCOVA) was conducted on the ratings of the target player. The scores of the control player were used as a covariate to control for any differences in rating scores when viewing identical footage. Before conducting each analysis, the data were examined to determine if they satisfied the assumptions of ANCOVA (Pallant, 2001). Independent sample *t*-tests were used when necessary to evaluate main effects, using a change value to control for the score of the covariate. Alpha was set at $P = 0.05$ for all statistical analyses.

## RESULTS

### Impact of order and judgment mode on ratings of the target player

The main assumption of ANCOVA is the test of equality of regression slopes. For each of the dependent variables (the combined construct, athleticism and attitude), the interactions between order and judgment condition for the covariates were not significant (see Appendix 2.4). Thus, this assumption was satisfied. In addition, Levene's test was not statistically significant for either of the covariates, therefore the assumption of homogeneity of variance was satisfied.

The 2 (ascending vs. declining order) x 4 (EoS vs. SbS_short vs. SbS_extended vs. delay condition) ANCOVA conducted on the ratings of the combined construct revealed a significant order by judgment condition interaction effect ($F_{3,231} = 2.62$, $P < .05$, effect size $\eta^2 = .03$, estimated power at 5% probability = .64). In addition, the results revealed a significant main effect for order ($F_{1,231} = 12.54$, $P < .05$, effect size $\eta^2 = .05$, estimated power at 5% probability = .94), but not a significant main effect for judgment condition ($F_{1,231} = 1.71$, $P > .05$, effect size $\eta^2 = .02$, estimated power at 5% probability = .45).

Independent sample t-tests, using a change value to control for the score of the covariate, revealed the ratings for the declining order were significantly higher than the ratings for the ascending order in the EoS condition (mean difference = 0.76, $t = 2.35$, df. = 58, $P < .05$). In addition, the results revealed a significant difference between the declining and ascending orders in the SbS (short) condition (mean difference = 1.13, $t = 3.58$, df. = 58, $P < .05$). These significant differences revealed primacy effects in the EoS condition, and the SbS condition that replicated the SbS processing used in Greenlees et al.'s (2007) study. The t-tests revealed no significant differences between the declining and ascending order in the SbS (extended) condition (mean difference = 0.01, $t = 0.03$, df. = 58, $P > .05$). Thus, no order effects were revealed for the extended SbS processing strategy. Finally, the t-tests revealed a significant difference between the declining and ascending orders in the delay condition (mean difference = 0.69, $t = 2.01$, df. = 58, $P < .05$). Thus, primacy effects were revealed in the delay condition. These significant differences are illustrated in Figure 3.6. To further investigate the way judgments were formed in the SbS (extended) condition, mean scores after each piece of evidence were calculated. These results can be seen in Figure 3.7.

For athleticism, the ANCOVA revealed no significant main effects for order ($F_{1,231} = .05$, $p > .05$, effect size $\eta^2 < .01$, estimated power at 5% probability = .05), or judgment condition ($F_{3,231} = .71$, $p > .05$, effect size $\eta^2 = .01$, estimated power at 5% probability = .20). In addition, no significant order by judgment condition interaction effect for athleticism were observed ($F_{3,231} = .46$, $p > .05$, effect size $\eta^2 = .01$, estimated power at 5% probability = .14).

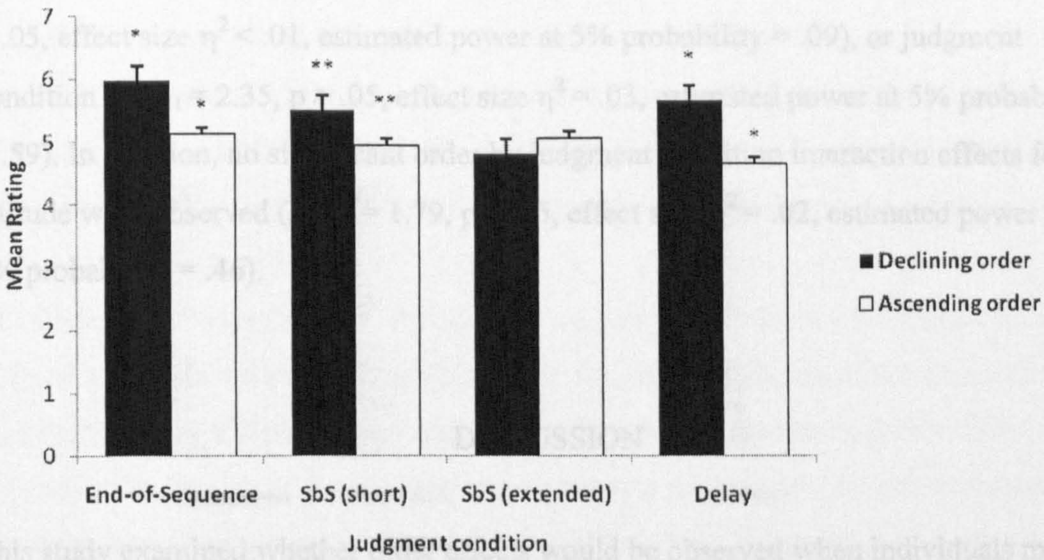



*Figure 3.6. Mean (+SE) ratings for combined construct for end-of-sequence, step-by-step (short), step-by-step (extended), and delay condition in declining and ascending orders of information.*

** Significant difference between declining and ascending order ($p < .01$).

* Significant difference between declining and ascending order ($p < .05$).

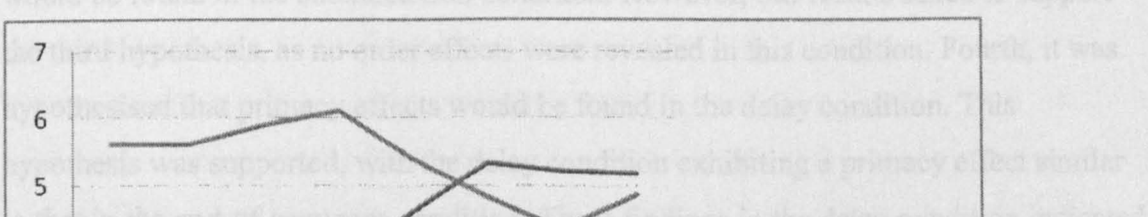



*Figure 3.7. Mean scores in the SbS extended condition (for the combined construct) for the declining and ascending orders of information after each piece of evidence.*

For attitude, the ANCOVA revealed no significant main effects for order ($F_{1,231} = .31$, $p > .05$, effect size $\eta^2 < .01$, estimated power at 5% probability = .09), or judgment condition ($F_{3,231} = 2.35$, $p > .05$, effect size $\eta^2 = .03$, estimated power at 5% probability = .59). In addition, no significant order by judgment condition interaction effects for attitude were observed ($F_{3,231} = 1.79$, $p > .05$, effect size $\eta^2 = .02$, estimated power at 5% probability = .46).

## DISCUSSION

This study examined whether order effects would be observed when individuals make assessments of sporting ability. More specifically, the study sought to explore whether order effects would be influenced by the type of judgment participants were asked to make. First, for the combined construct of ultimate frisbee ability, disc control, and speed-of-thought, primacy effects were found in the end-of-sequence (EoS) condition, as hypothesised. Second, it was hypothesised that primacy effects would be found in the step-by-step (SbS) condition that replicated the SbS manner of processing used in Greenlees et al.'s (2007) study. As hypothesised, primacy effects were displayed in this condition for the combined construct. Third, it was hypothesised that recency effects would be found in the extended SbS condition. However, our results failed to support the third hypothesis, as no order effects were revealed in this condition. Fourth, it was hypothesised that primacy effects would be found in the delay condition. This hypothesis was supported, with the delay condition exhibiting a primacy effect similar to that in the end-of-sequence condition. These findings in the delay condition indicated the extended step-by-step processing condition, rather than any time delay, eliminated the primacy effects. No significant order effects were found for athleticism or attitude.

The results supported the first hypothesis that primacy effects would be displayed in the EoS condition, where participants were asked to make just one judgment of ability after viewing all the clips. This finding is in line with the predictions of Hogarth and Einhorn's (1992) model and is consistent with the results of Greenlees et al.'s (2007) study and previous published reports of order effects in ability assessments (Jones et al., 1968; Newtson & Rindner, 1979; McAndrew, 1981; Benassi, 1982). Thus, the results of the present study support the notion that primacy effects are a robust finding when a single EoS assessment of ability is made. Hogarth and Einhorn propose in the EoS condition, a person anchors their judgment on initial evidence, and only one further adjustment is made after all evidence is viewed. Thus, primacy emerges due to the heavy weighting of early information, and lesser weighting of later information.

The findings have implications for coaches, selectors, and others who make a single judgment of ability after viewing a player, as the results suggest initial information will bias assessments of a player's overall ability. Coaches might assess ability differently depending on the player's initial performance levels. In light of this, observers should be made aware how order of information might bias their judgments of a player. In addition, athletes should be made aware that a strong initial start in their performance may create a positive impression on those assessing them. In the competitive environment, such impressions might create favourable outcomes for a player in view of the responses opponents make as consequences of the impressions developed (Warr & Knapper, 1968). For example, strong initial play might result in an opponent's confidence declining, leading to the opponent having negative expectations of success.

Second, it was hypothesised that primacy effects would be found for the SbS processing used in Greenlees at al.'s (2007) study. The results supported this hypothesis. Hogarth and Einhorn (1992) explain how SbS processing results in later information having greater weighting. This can be represented by the equation $S_k = S_{k-1} + w_k[s(x_k) - R]$, where $w_k$ represents the adjustment weight of a piece (the $k$th piece) of evidence. With a weak method of SbS processing, the adjustment weight ($w_k$) is reduced, meaning later evidence had less weighting on the overall judgment. Thus, it appears the weighting of the later evidence was not strong enough to offset the influence of the initial anchor, and consequently this SbS processing strategy failed to eliminate primacy effects.

Third, it was hypothesised that recency effects would occur when participants made more thorough SbS judgments. The results indicated this SbS processing strategy eliminated primacy effects, but the predicted recency effects did not occur. This can tentatively be explained by considering the strength of initial information (the anchor) compared to the weighting of later evidence. Jones et al. (1968) argued that as ability is seen as a stable entity, initial information is given much greater weighting than may be the case when other judgments are required. Referring back to the equation $S_k = S_{k-1} + w_k[s(x_k) - R]$, the extended SbS strategy meant the adjustment weight ($w_k$) of later information for this processing was greater than the weighting for the incomplete measure of SbS processing. Consequently, the increased weighting of later evidence meant the influence of the anchor was offset. However, if the initial anchor was sufficiently strong, then this SbS manipulation may only have the strength to reduce primacy effects and leave no order effects (rather than reversing primacy effects to recency effects as suggested by Hogarth and Einhorn). Further research is needed before such a proposal can be substantiated. The temporal patterning of the mean ratings after each piece of evidence, are represented in Figure 3.7. This line graph shows how the anchor is formed by the first piece of evidence, and then the remaining evidence in the declining and ascending orders brings the judgments to an (approximately) equal score. Thus, the graphs demonstrate visually how additional processing from the SbS strategy reduces the strength of the initial impression, and offsets primacy, but not by enough to produce a recency effect.

These results extend the findings of Greenlees et al. (2007) who only asked for one overall assessment of ability after each clip in the SbS condition. These results were replicated in the present study in the similar SbS condition. The present study also used a more thorough measure of SbS processing in an additional SbS condition, with participants asked to provide all four ratings after each single piece of evidence. Therefore, the improved manipulation forced participants to fully update their judgment after each new piece of evidence. Thus, the results of the present study indicate it is through the process of making fuller SbS judgments that primacy effects are offset.

The results of the present study supported hypothesis 4, with primacy effects found when a delay was inserted between pieces of evidence. This finding suggests that the delay created by making step-by-step judgments had been controlled for, thus eliminating delay as a potential confounding variable. Consequently, it is proposed that it was through making step-by-step judgments that a move away from primacy occurred. These results in the delay condition failed to replicate the findings of Luchins (1957) and Miller and Campbell (1959), who found that a delay caused a move away from primacy and towards recency. The delay in these latter studies, however, was different to the nature of the delay in the present study. In these earlier studies, evidence was presented in two blocks of information in either an ascending or descending order, with a single delay included between the two blocks of evidence. In light of this, it is plausible to suggest that small, regular delays are not enough to impact on primacy effects. In contrast, one lengthy delay might create a break between information, thus producing recency effects, as more recent information has a stronger presence in the short-term memory (Miller & Campbell, 1959). Thus, in Luchins' study, earlier information had less influence as the delay allowed greater consideration of the contrasting evidence. It is unlikely in the present study that small delays of only 12 seconds between clips were long enough to prevent the evidence being viewed as one block of information. Consequently, primacy effects emerged in the delay condition as in the EoS condition.

Luchins (1957) found a delay of five minutes between blocks of evidence weakened primacy and caused a move towards recency. In further studies investigating delay, Luchins found that a 17 minute delay caused a greater recency effect. In light of these findings, Luchins highlighted the need for a systematic investigation of how various time intervals might influence order effects. Such an investigation is beyond the scope of the present thesis, but does provide an interesting future line of research to investigate the impact of delays on order effects. Such information would have applied implications for selectors or coaches when making assessments of ability in a sporting context. For example, if a player is viewed, and then a delay occurs before they are viewed again, this delay might impact on order effects. Furthermore, various lengths of delay might have differing influences on order effects in overall judgments of ability.

The results of the present study support the notion that primacy may be a robust finding in ability assessments when end-of-sequence judgements are made, but has shown that a fuller step-by-step processing strategy offsets primacy effects. Consequently, these findings could inform the development of practical coaching guidelines. More specifically, individuals who frequently make attributions of ability should be guided to make detailed evaluations of performance regularly in order to offset primacy effects, thus replicating the extended step-by-step condition. For example, coaches might devise an assessment template, thus allowing judgements to be updated after new evidence is viewed.

In summary, the results of this study provide further support that primacy effects are found when EoS judgments are made, and no order effects emerge when more thorough SbS judgments are made. In addition, the results of the present study eliminated the time delay between evidence as a confounding variable in the SbS condition. Consequently, these findings suggest that primacy effects can be offset when SbS processing is used. Following his early studies on order effects in impression formation, Luchins (1957) suggested future research might explore whether certain personality traits impact on order effects. Thus, future research is needed to investigate if people have a tendency towards primacy or recency, in light of various personality differences, or whether the results of the present study can be generalised.

# CHAPTER 4

## STUDY 2: INVESTIGATING PERSONALITY VARIABLES AS POTENTIAL MODERATORS OF ORDER EFFECTS.

Researchers (e.g. Asch, 1946; Anderson, 1991; Hogarth & Einhorn, 1992) have offered various theories and models to explain the presence of order effects. For example, Hogarth and Einhorn proposed in their belief-adjustment model that six factors influence whether primacy or recency effects occur. However, these theories and models each fail to consider how trait characteristics of participants making the judgments might influence order effects. Indeed, following his early findings of order effects in impression formation, Luchins (1957) suggested it might be worth exploring whether certain personality traits impact on order effects. The purpose of the present study was therefore to provide a more thorough examination of certain personality traits that might influence primacy or recency effects occurring. Furthermore, from an applied perspective, an understanding of how personality traits influence order effects could help inform which individuals are susceptible to judgmental biases caused by order effects.

Only a limited number of studies have examined the role of personality variables in determining the direction of order effects. Therefore, the present study aimed to extend understanding of how order effects might impact on assessments of sporting ability, through investigating whether personality variables impact on the incidence of order effects. The three variables examined were an individual's theory of the nature of learning (whether they are an entity or incremental theorist); an individual's level of motivation to think; and an individual's level of experience. These variables were chosen as they have previously been investigated in order effect research (e.g. nature of theory of learning, Butler, 2000; motivation to think, Ahlering & Parker, 1989; experience, Aldeman, Tolcott, & Bresnick, 1993). Furthermore, previous findings from research in this area, together with theoretical arguments (e.g. Hogarth & Einhorn, 1992), allowed specific hypotheses to be developed and tested in the present study.

### Implicit theory of ability

The first personality variable worthy of exploration is a person's belief in the nature of ability. There are two beliefs concerning ability, entity beliefs which view ability as fixed, and incremental beliefs which view ability as changeable, and able to be improved (Butler, 2000). Erdley and Dweck (1993) investigated judgments children made after viewing behaviours of a target child. The results showed children categorised as entity theorists were more influenced by early information (primacy effects), and were less likely to revise their judgments in the face of disconfirming evidence. In another study examining impressions of academic ability, Butler (2000) found entity theorists inferred higher ability about others when performance declined (primacy effects), and incremental theorists inferred higher ability when viewing an improving performance (recency effect).

In light of these findings, it appears those who view ability as being at a fixed level (entity theorists) would be more susceptible to primacy effects when making assessments of ability. Theoretically, entity theorists believe ability is fixed, and settle on their initial impressions, and later information will have low weighting on the overall impression, even when SbS judgments are required. Alternatively, incremental theorists believe ability can be developed. Therefore, in the EoS condition, incremental theorists are likely to consider all evidence, as their impressions are based on the effort and learning that takes place. With this additional processing, recency is expected in both the EoS and SbS conditions.

*Hypothesis 5*

In both the EoS and SbS response conditions, primacy effects are predicted for entity theorists.

*Hypothesis 6*

In both the EoS and SbS response conditions, recency effects are predicted for incremental theorists.

<u>Motivation to Think</u>

An individual's motivation to think about all information presented is a further personality variable that might moderate order effects. Petty and Wegener (1999) suggested that when motivated to engage in greater scrutiny, one's initial impressions can be modified. In contrast, with low motivation to think, people look for a simple, quick ways to judge the merits of information, rather than examining it all carefully. In their study examining levels of motivation to think, Ahlering and Parker (1989) presented participants with adjectives in differing orders to describe a target person, and found an interaction between the order of information and level of motivation to think. More specifically, the results revealed primacy effects for those with low motivation to think. However, primacy effects were offset for individuals high in motivation to think. Theoretically, individuals with low motivation to think develop an early impression, which is unlikely to change as they lack motivation to process subsequent information carefully. In contrast, individuals high in motivation to think do not settle for their first impression, as they consider later evidence more thoughtfully.

Hogarth and Einhorn (1992) suggested that even when an EoS response is required, it is possible that those with high motivation to think will use an SbS processing strategy. If those with high motivation to think engage in effortful SbS processing, it is likely that primacy effects will be offset. In line with Hogarth and Einhorn's theorising, SbS processing was expected to force participants into more fully processing, and was thus expected to offset primacy effects for both levels of motivation to think.

*Hypothesis 7*
In the EoS response condition, primacy effects are predicted for participants with low motivation to think.

*Hypothesis 8*
In the EoS response condition, no order effects are predicted for participants with high motivation to think.

*Hypothesis 9*
In the SbS response condition, no order effects are predicted for either motivation to think group.

<u>*Experience*</u>
Hogarth and Einhorn (1992) link complexity with the amount of experience a participant has. They suggest experienced participants are more familiar with the evidence, finding it simpler and easy to process as they have more cognitive resources at their disposal. In

contrast, participants with less experience are expected to find information unfamiliar and therefore more complex. Thus, those with less experience are likely to use strategies such as SbS processing to handle the cognitive strain of dealing with complex information. Therefore, in light of greater processing of later information, lower experience is likely to reduce primacy effects and produce recency effects (Hogarth & Einhorn).

In the impression formation literature, there is some support for these predictions concerning the influence of experience on order effects. For example, Aldeman, Tolcott, and Bresnick (1993) used an Army air defence task to investigate perceptions of incoming information as either 'friends or foes' (p.352). The results revealed judgments made by less experienced participants showed stronger recency effects in the SbS judgment condition. In addition, less experienced auditors were found to exhibit recency effects (Kennedy, 1993; Messier & Tubbs, 1994). Kennedy concurred with the predictions of the belief-adjustment model, proposing that when evidence is more complex, it is likely participants use an SbS strategy to increase their ability to cope with the cognitive demands of the task. However, Greenlees et al. (2007) found experience had no impact on order effects. Greenlees and colleagues investigated participants' impressions of a soccer player's ability, and used soccer coaches, players and non-players to examine if different levels of experience influenced order effects. In contrast to the predictions of Hogarth and Einhorn's (1992) model, the results from Greenlees et al.'s study revealed primacy effects across all levels of experience.

Hogarth and Einhorn's (1992) model predicts primacy in the EoS condition. However, they considered studies that found recency effects when an EoS response was asked for, and suggested that when an EoS response is asked for, participants might still use SbS processing. Thus, if inexperienced participants find information complex, they might adopt an SbS strategy to deal with the cognitive demands of the task. Thus, in the EoS condition, no order effects would be expected for less experienced participants. For more experienced participants, information would be considered simple. For simple information, when EoS judgments are required, Hogarth and Einhorn's model predicts primacy effects. In the SbS condition, no order effects would be expected if both high and low experienced participants processed information in an SbS manner.

*Hypothesis 10*

In the EoS response condition, primacy effects are predicted for more experienced participants.

*Hypothesis 11*

In the EoS response condition, no order effects are predicted for less experienced participants.

*Hypothesis 12*

In the SbS response condition, no order effects are predicted for either level of experience.

## METHOD

### Participants

The participants in this study consisted of 160 club standard ultimate frisbee players (97 male, 63 female) with a mean age of 22.76 years (SD = 3.78 years). Participants' mean playing experience was 3.53 years (SD = 2.95 years). The sample was predominantly white Caucasian (*n* = 153), with the remainder coming from Asian (*n* = 5) and mixed race (*n* = 2) backgrounds. All were volunteers and signed informed consent forms prior to participation. The study was approved by the Ethics Committee at the University of Chichester.

### Materials

The stimuli used in this section were the 2 DVD's used in the previous study.

### Measures

*Ratings of the player's ability.* To examine their impressions of the players observed, participants were asked to rate each model on four factors (ultimate frisbee ability (general), disc control, speed of thought, and athleticism) used in Study 1. Attitude was removed from this measurement, as it was considered a psychological trait, and not a measure of ability. Each factor was measured on a 10 point, likert-type scale (e.g., 1 = poor to 10 = excellent). The alpha coefficient for the combined construct in the present study was 0.90.

*Implicit theory of ability.* Participants read and responded to three items, adapted from Dweck and Henderson's (1986) measure of theory of intelligence, and further used by Butler (2000). The items were "everyone has a certain amount of sporting/ultimate frisbee ability, and one can't do much to change this amount"; "One's sporting/ultimate frisbee ability is something about oneself that one can't change much"; and "people can learn new things in sport/ultimate frisbee, but they can't change their basic sporting/ultimate frisbee ability". Participants rated their agreement to items on a 6-point scale anchored by *strongly disagree* (1) to *strongly agree* (6). Following Dweck and Henderson (1986), in the present study, participants were classified as entity theorists if their average score on the three implicit theory items was higher or equal to 4.00, and as incremental theorists if their score was lower or equal to 3.00, and neither if they scored between 3.00 and 4.00. The alpha coefficient for the scale in the present study was 0.81.

*Need for Cognition.* The Need for Cognition Scale (NCS; Cacioppo, Petty, & Kao, 1984) was used to distinguish those individuals who tend to engage in effortful analytical activity from those who do not. The NCS is a highly reliable measure, with Cronbach's alphas exceeding .84 across six studies; and split-half and test–retest reliabilities averaging .83 and .87 respectively (Cacioppo et al., 1996). The short form of the NCS comprises of 18 items, which concern a person's reactions to engaging in effortful thinking in a variety of situations. An example item from the scale is 'I prefer to think about small, daily projects to long-term ones'. Participants responded on a 5-point scale anchored by *extremely uncharacteristic of me* (1) to *extremely characteristic of me* (5). After completing the NCS scale, a median split was performed to create the high and low need for cognition groups in the present study. In this sample, the range of scores was 45 to 82 (possible range = 18 to 90). The median score was 65.7. The alpha coefficient for the NCS in the present study was 0.79.

*Experience.* Participants were asked how long they had been playing ultimate frisbee. A median split was conducted to create the high and low experience group. In the present study, the range of experience was 0.5 to 20 years. The mean level of experience was 3.53 years. An independent sample t-test revealed the mean years of experience ($M$ = 5.39, $SD$ = 3.18) for the higher experience group were significantly higher than the mean years of experience ($M = 7.16$, $SD = .74$) for the lower experience group (mean difference = 3.73, $t = 10.28$, $df. = 158$, $P < .001$).

Procedure

The initial procedure was identical for Study 1, with data collected in the present study over four weekend tournaments. Participants were assigned randomly to view either the declining or ascending order of information, and were randomly assigned to either the end-of-sequence (EoS) or step-by-step (SbS) judgment condition. After viewing the DVD footage and assessing the ability of the control and target players, participants were then instructed to fill in the two additional inventories concerning nature of ability and motivation to think. From their responses, participants were classified as either 1) entity or incremental theorists, 2) high or low in need for cognition, and 3) high or low in level of experience.

Data Analysis

Means, standard deviations, and Pearson correlations for both the control and target players are presented in Table 4.1. As in the previous Study, high correlations emerged between three of the variables. The Pearson correlations indicated that for the target player, the correlations between ultimate ability and disc control (.81), between ultimate ability and speed of thought (.75), and between disc control and speed of thought (.70) exceeded Tabachnick and Fidell's (1996) criterion value of .70. Thus, for data analysis, there were two dependent variables. The scores of the ultimate ability, disc control, and speed of thought were averaged to give a single rating for this combined construct, which formed one independent variable. Athleticism was retained as single-item question, and was the second dependent variable.

Two-way univariate analyses of covariance (ANCOVAs) were conducted to examine the ratings of the target player. Separate ANCOVAs were conducted to test the hypothesised relationships in each judgment condition (EoS and SbS). The first ANCOVAs examined the interactions between order of presentation and theory of learning, the second ANCOVAs examined the interactions between order of

| Variable | M | SD | Subscale | | | |
|---|---|---|---|---|---|---|
| | | | 1 | 2 | 3 | 4 |
| Control ratings (*n* = 160) | | | | | | |
| 1. Ultimate Frisbee Ability | 6.53 | 1.08 | - | .79(**) | .73(**) | .62(**) |
| 2. Disc Control | 6.72 | 1.16 | - | - | .67(**) | .55(**) |
| 3. Speed of Thought | 6.40 | 1.25 | - | - | - | .43(**) |
| 4. Athleticism | 6.48 | 1.08 | - | - | - | - |
| Target ratings (*n* = 160) | | | | | | |
| 1. Ultimate Frisbee Ability | 5.14 | 1.29 | - | .81(**) | .75(**) | .68(**) |
| 2. Disc Control | 5.26 | 1.43 | - | - | .70(**) | .50(**) |
| 3. Speed of Thought | 5.06 | 1.39 | - | - | - | .56(**) |
| 4. Athleticism | 4.91 | 1.24 | - | - | - | - |

**p<.01

*Table 4.1. Rating means, standard deviations, and intercorrelations between subscales.*

presentation and level of need for cognition, and the third ANCOVAs examined the interactions between order of presentation and level of experience. The scores of the control player were used as a covariate to control for any differences in rating scores when viewing identical footage. Before conducting each analysis, the data were examined to determine if it satisfied the assumptions of ANCOVA (Pallant, 2001). Independent sample t-tests were used when necessary to evaluate main effects, using a change value to control for the score of the covariate. Alpha was set at $P = 0.05$ for all statistical analyses.

## RESULTS

For all of the analyses, the test of equality of regression slopes revealed these assumptions were not violated (see Appendix 3.2). In addition, Levene's test was not statistically significant for the covariate in any of the analyses, therefore the assumptions of homogeneity of variance were satisfied.

### <u>Impact of order, judgment mode, and theory of learning on ratings of the target player</u>

The 2 (declining vs. ascending order) x 2 (entity vs. incremental learning theory belief) ANCOVA conducted on the ratings of the combined construct for the target player in the EoS judgment condition revealed a significant main effect for order ($F_{1,62} = 10.67$, $p < .01$, effect size $\eta^2 = .15$, estimated power at 5% probability = .90). However, the results revealed no significant main effect for theory of learning ($F_{1,62} = 1.26$, $p > .05$, effect size $\eta^2 = .02$, estimated power at 5% probability = .20). In addition, no significant order by learning theory interaction effects were observed ($F_{1,62} = .16$, $p > .05$, effect size $\eta^2 < .01$, estimated power at 5% probability = .07). Thus, in the EoS condition, the main effect for order revealed a primacy effect regardless of participants' theory of learning beliefs. This main effect is illustrated in Figure 4.1.

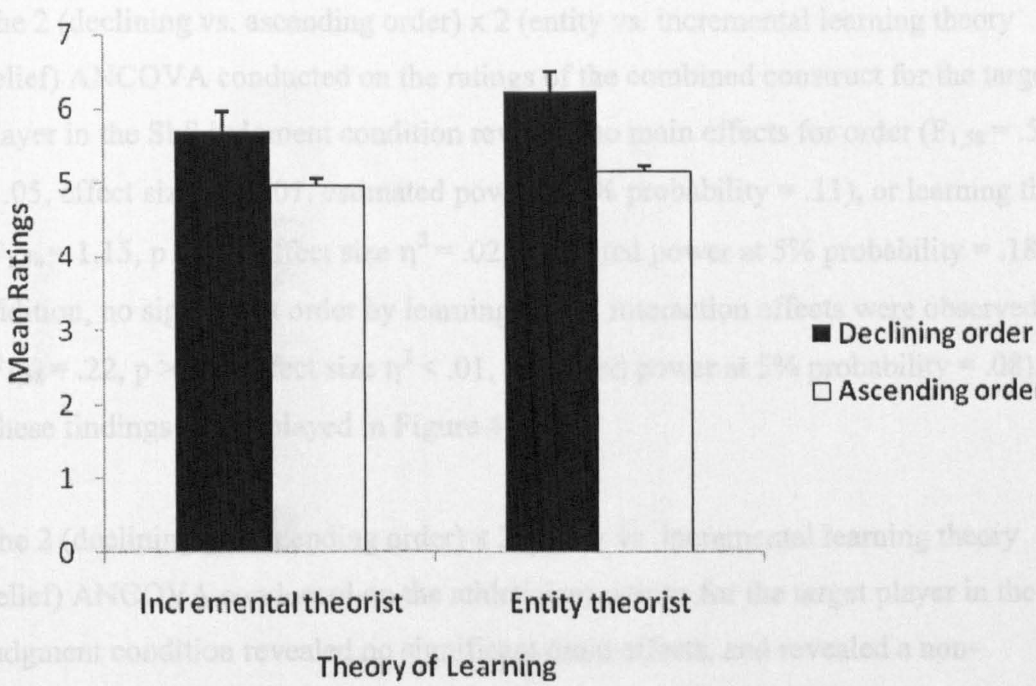



*Figure 4.1. Mean (+SE) ratings for entity and incremental theorists, comparing the declining and ascending orders of information (in the EoS judgment condition).*

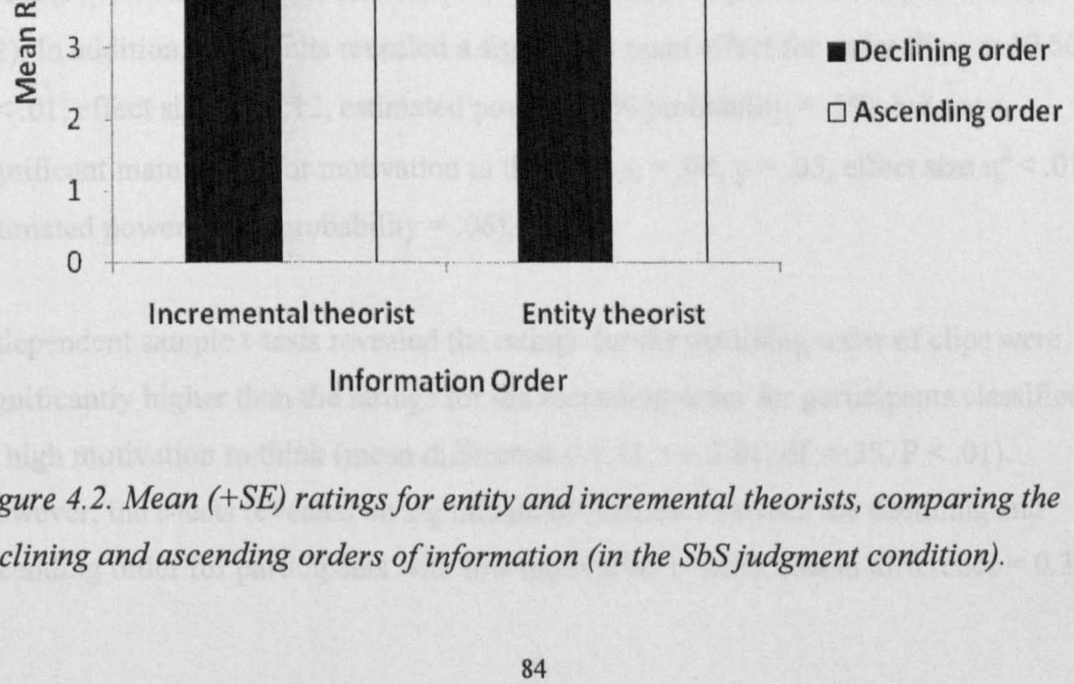



*Figure 4.2. Mean (+SE) ratings for entity and incremental theorists, comparing the declining and ascending orders of information (in the SbS judgment condition).*

The 2 (declining vs. ascending order) x 2 (entity vs. incremental learning theory belief) ANCOVA conducted on the ratings of the combined construct for the target player in the SbS judgment condition revealed no main effects for order ($F_{1,58} = .52$, $p > .05$, effect size $\eta^2 = .01$, estimated power at 5% probability = .11), or learning theory ($F_{1,58} = 1.15$, $p > .05$, effect size $\eta^2 = .02$, estimated power at 5% probability = .18). In addition, no significant order by learning theory interaction effects were observed ($F_{1,58} = .22$, $p > .05$, effect size $\eta^2 < .01$, estimated power at 5% probability = .08). These findings are displayed in Figure 4.2.

The 2 (declining vs. ascending order) x 2 (entity vs. incremental learning theory belief) ANCOVA conducted on the athleticism ratings for the target player in the EoS judgment condition revealed no significant main effects, and revealed a non-significant order by learning theory interaction effect. Similarly, the ANCOVA conducted on the athleticism rating for the target player in the SbS judgment condition revealed no significant main effects, and revealed a non-significant order by learning theory interaction effect (see Appendix 3.2 for full details of ANCOVA statistics).

<u>Impact of order, judgment mode, and motivation to think on ratings of the target player</u>

The 2 (declining vs. ascending order) x 2 (high vs. low need for cognition) ANCOVA conducted on the ratings of the combined construct for the target player in the EoS judgment condition revealed a significant order by motivation to think interaction effect ($F_{1,75} = 5.23$, $p < .05$, effect size $\eta^2 = .07$, estimated power at 5% probability = .62). In addition, the results revealed a significant main effect for order ($F_{1,75} = 10.56$, $p < .01$, effect size $\eta^2 = .12$, estimated power at 5% probability = .89), but not a significant main effect for motivation to think ($F_{1,75} = .08$, $p > .05$, effect size $\eta^2 < .01$, estimated power at 5% probability = .06).

Independent sample t-tests revealed the ratings for the declining order of clips were significantly higher than the ratings for the ascending order for participants classified as high motivation to think (mean difference = 1.11, $t = 3.01$, df. = 38, $P < .01$). However, the t-tests revealed no significant differences between the declining and ascending order for participants with low motivation to think (mean difference = 0.30,

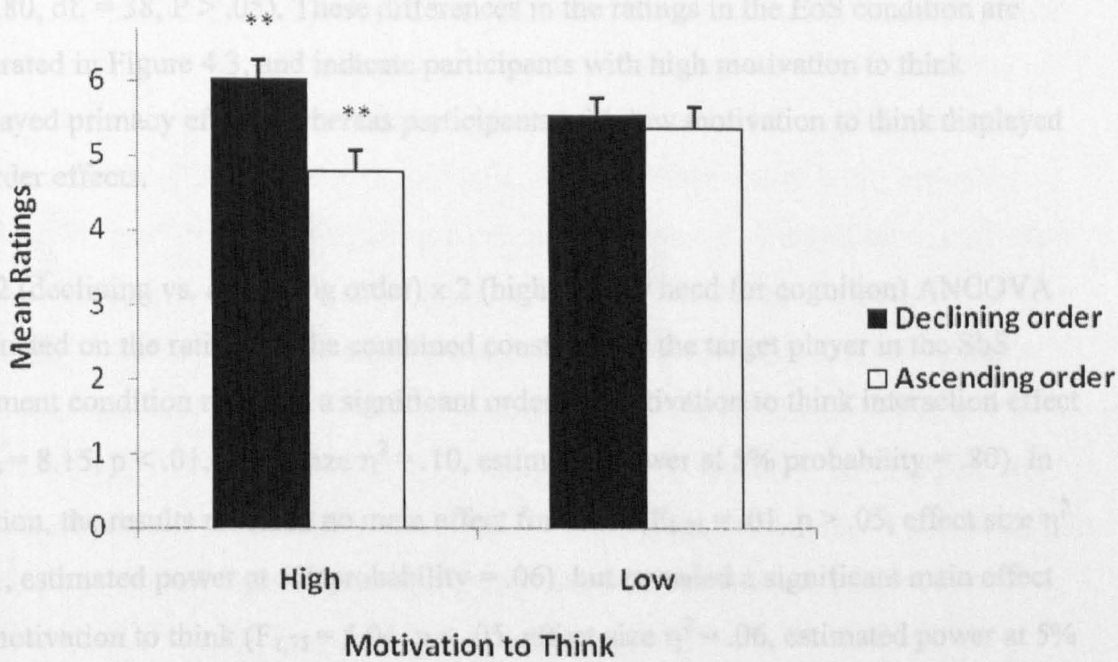



*Figure 4.3. Mean (+SE) ratings for participants with high and low motivation to think, comparing declining and ascending orders of information (in the EoS judgment condition).*

** Significant difference between declining and ascending order ($p < .01$).

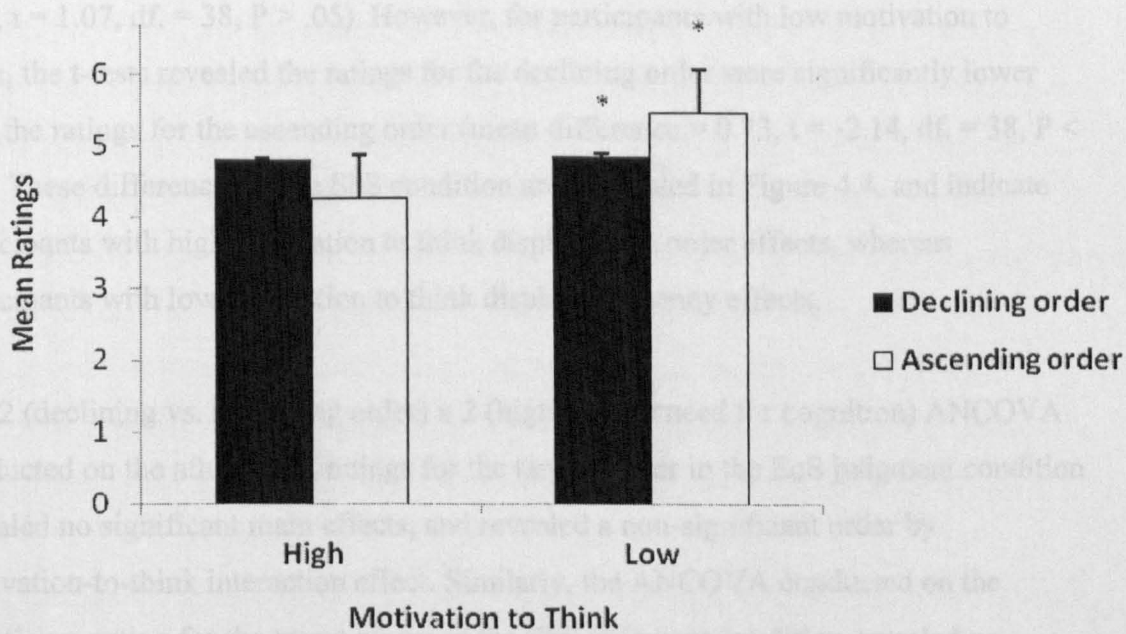



*Figure 4.4. Mean (+SE) ratings for participants with high and low motivation to think, comparing declining and ascending orders of information (in the SbS judgment condition).*

** Significant difference between declining and ascending order ($p < .05$).

$t = 0.80$, df. = 38, $P > .05$). These differences in the ratings in the EoS condition are illustrated in Figure 4.3, and indicate participants with high motivation to think displayed primacy effects, whereas participants with low motivation to think displayed no order effects.

The 2 (declining vs. ascending order) x 2 (high vs. low need for cognition) ANCOVA conducted on the ratings of the combined construct for the target player in the SbS judgment condition revealed a significant order by motivation to think interaction effect ($F_{1,75} = 8.15$, $p < .01$, effect size $\eta^2 = .10$, estimated power at 5% probability = .80). In addition, the results revealed no main effect for order ($F_{1,75} = .01$, $p > .05$, effect size $\eta^2 < .01$, estimated power at 5% probability = .06), but revealed a significant main effect for motivation to think ($F_{1,75} = 5.04$, $p < .05$, effect size $\eta^2 = .06$, estimated power at 5% probability = .60).

Independent sample t-tests revealed no significant differences between the declining and ascending order for participants with high motivation to think (mean difference = 0.50, $t = 1.07$, df. = 38, $P > .05$). However, for participants with low motivation to think, the t-tests revealed the ratings for the declining order were significantly lower than the ratings for the ascending order (mean difference = 0.73, $t = -2.14$, df. = 38, $P < .05$). These differences in the SbS condition are illustrated in Figure 4.4, and indicate participants with high motivation to think displayed no order effects, whereas participants with low motivation to think displayed recency effects.

The 2 (declining vs. ascending order) x 2 (high vs. low need for cognition) ANCOVA conducted on the athleticism ratings for the target player in the EoS judgment condition revealed no significant main effects, and revealed a non-significant order by motivation-to-think interaction effect. Similarly, the ANCOVA conducted on the athleticism rating for the target player in the SbS judgment condition revealed no significant main effects, and revealed a non-significant order by motivation-to-think interaction effect (see Appendix 3.2 for full details of ANCOVA statistics).

Impact of order, judgment mode, and level of experience on ratings of the target player

The 2 (declining vs. ascending order) x 2 (high vs. low experience) ANCOVA was conducted on the ratings of the target player in the EoS judgment condition revealed a significant main effect for order ($F_{1,75} = 9.91$, $p < .01$, effect size $\eta^2 = .12$, estimated power at 5% probability =.87). However, the results revealed no significant main effect for level of experience ($F_{1,75} = .18$, $p > .05$, effect size $\eta^2 < .01$, estimated power at 5% probability = .07). In addition, no significant order by level of experience interaction effect was observed ($F_{1,75} = .43$, $p > .05$, effect size $\eta^2 = .01$, estimated power at 5% probability = .10). Thus, in the EoS condition, the main effect for order of experience ($F_{1,75} = .18$, $p > .05$, effect size $\eta^2 < .01$, estimated power at 5% revealed a primacy effect regardless of the level of experience. Figure 4.5 illustrates this main effect.

In the SbS judgment condition, the ANCOVA revealed no main effects for order ($F_{1,76}$ =.15, $p > .05$, effect size $\eta^2 = .09$, estimated power at 5% probability = .07), or level of experience ($F_{1,76} = 1.19$, $p > .05$, effect size $\eta^2 = .02$, estimated power at 5% probability = .19). However, the results revealed a significant order by level of experience interaction effect ($F_{1,76} = 7.01$, $p < .05$, effect size $\eta^2 = .09$, estimated power at 5% probability = .74). Independent sample t-tests revealed no significant differences between the declining and ascending order for participants with a higher level of experience (mean difference = 0.56, $t = 1.38$, df. = 37, $P > .05$). However, for participants with a lower level of experience, the t-tests revealed the ratings for the declining order were significantly lower than the ratings for the ascending order for participants (mean difference = 0.84, $t = -2.16$, df. = 39, $P < .05$). These differences in the ratings in the SbS condition are illustrated in Figure 4.6, and indicate participants with higher experience displayed no order effects, whereas participants with lower experience displayed recency effects.

The 2 (declining vs. ascending order) x 2 (high vs. low level of experience) ANCOVA conducted on the athleticism ratings for the target player in the EoS judgment condition revealed no significant main effects, and revealed a non-significant order by experience interaction effect. Similarly, the ANCOVA conducted on the athleticism rating for the target player in the SbS judgment condition revealed no significant main effects, and revealed a non-significant order by experience interaction effect (see Appendix 3.2 for full details of ANCOVA statistics).

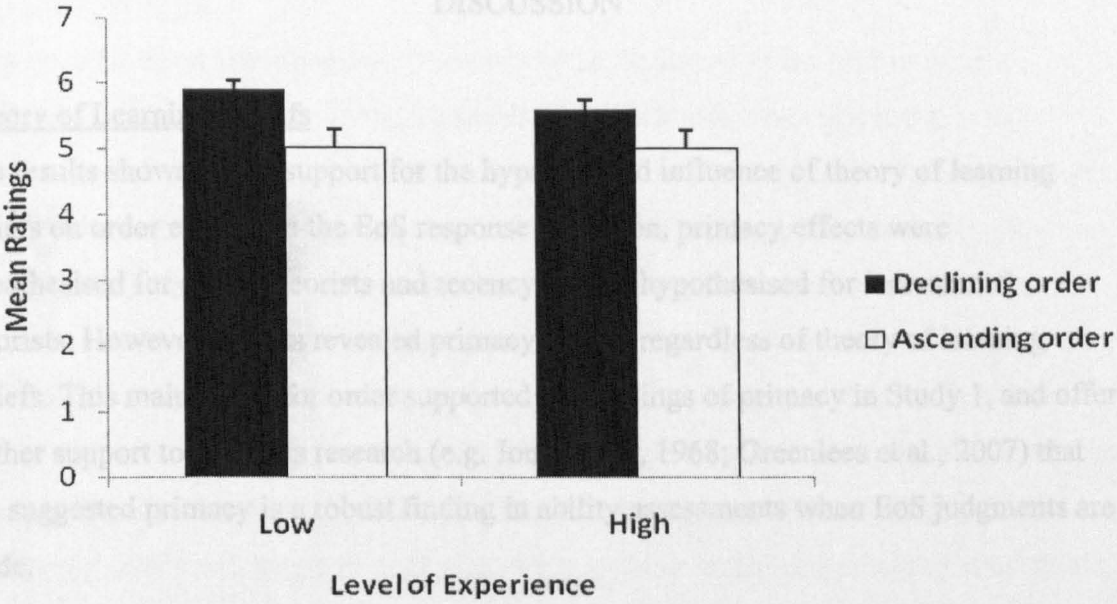



*Figure 4.5. Mean (+SE) ratings for the low and high levels of experience, comparing declining and ascending orders of information (in the EoS judgment condition).*

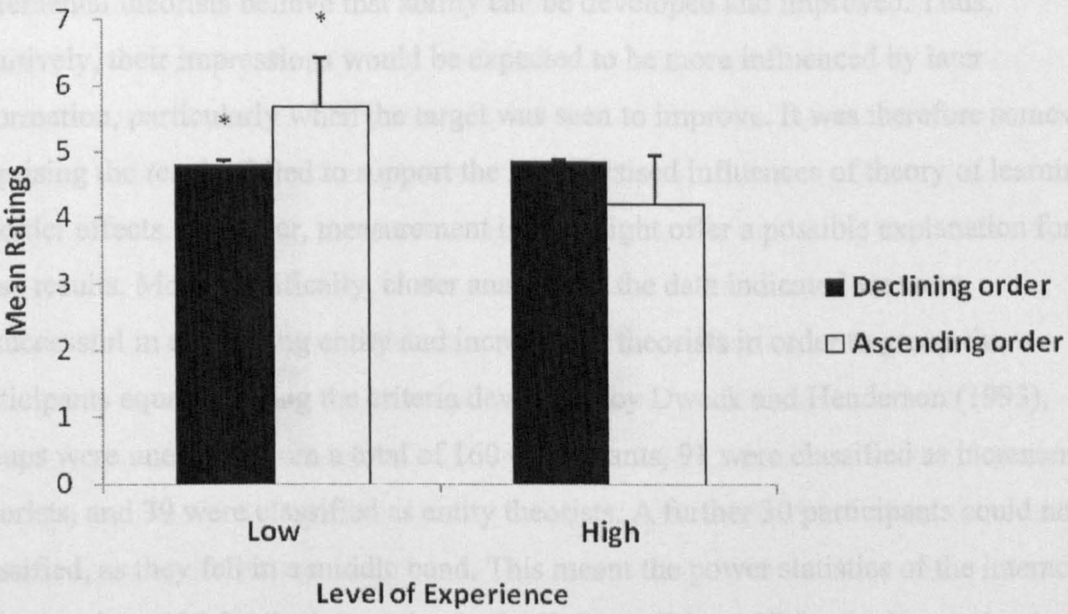



*Figure 4.6. Mean (+SE) ratings for the low and high levels of experience, comparing the declining and ascending orders of information (in the SbS judgment condition).*

* Significant difference between declining and ascending order ($p < .05$).

# DISCUSSION

## Theory of Learning Beliefs

The results showed little support for the hypothesised influence of theory of learning beliefs on order effects. In the EoS response condition, primacy effects were hypothesised for entity theorists and recency effects hypothesised for incremental theorists. However, results revealed primacy effects regardless of theory of learning beliefs. This main effect for order supported the findings of primacy in Study 1, and offer further support to previous research (e.g. Jones et al., 1968; Greenlees et al., 2007) that has suggested primacy is a robust finding in ability assessments when EoS judgments are made.

In the SbS condition, it was hypothesised that entity theorists would display primacy effects, and incremental theorists would display recency effects. However, the results showed no significant differences in order effects due to participants' theories of learning beliefs. Theoretically, the rationale for the hypothesis was sound. For example, incremental theorists believe that ability can be developed and improved. Thus, intuitively, their impressions would be expected to be more influenced by later information, particularly when the target was seen to improve. It was therefore somewhat surprising the results failed to support the hypothesised influences of theory of learning on order effects. However, measurement issues might offer a possible explanation for these results. More specifically, closer analysis of the data indicated we were unsuccessful in classifying entity and incremental theorists in order to group the participants equally. Using the criteria developed by Dweck and Henderson (1993), groups were unequal. From a total of 160 participants, 91 were classified as incremental theorists, and 39 were classified as entity theorists. A further 30 participants could not be classified, as they fell in a middle band. This meant the power statistics of the interactions were very low (.05 for the interaction in the EoS condition; .07 for the interaction in the SbS condition). Nevertheless, the p-values were not close to significance, so the results showed no indication that significant results would have been found with a more powerful test (e.g. more participants, equal group sizes). Thus, the results offered no support for our hypotheses that beliefs on the theory of learning influence order effects.

Motivation to Think

It was hypothesised that no order effects would be displayed in the EoS judgment condition for participants with high motivation to think. Alternatively, it was hypothesised that individuals with low motivation to think would display primacy effects, as they would develop an early impression and stick with this due to a lack of motivation to fully process remaining information. However, the results were in contrast to these hypothesised relationships, with participants high in motivation to think showing primacy effects in the EoS condition, and the low motivation to think group displaying no order effects. It was also hypothesised no order effects would be displayed in the SbS condition for either level of motivation to think. The results showed partial support for this hypothesis, with participants high in motivation to think displaying no significant order effects. However, participants with low motivation to think displayed recency effects.

It was hypothesised participants with greater motivation to think would more effortfully process all the information, in a manner similar to SbS processing. An SbS strategy was predicted to result in the greater weighting of later information, which was expected to offset primacy effects. However, the results suggest the higher motivation to think group gave greater weighting to the initial evidence compared to later evidence. A plausible explanation is that participants with higher motivation to think did use an SbS processing strategy but still primacy effects still emerged. This might be due to the strength of the initial anchor, and that the SbS processing used was not enough to offset the influence of the early information. In line with this, primacy could further be explained by 'cognitive dissonance theory' (Learner & Tetlock, 1999) which predicts that once people have committed themselves to a decision, greater cognitive effort towards the task will produce effortful processing, but this effort will be directed towards self-justification. Learner and Tetlock suggested this prompts a defensive bolstering of the initial opinion developed, with participants focussing energy on rationalising the early opinion they have developed. Relating this back to Hogarth and Einhorn's model algebraic equation; $S_k = S_{k-1} + w_k[s(x_k) - R]$, the initial anchor ($S_{k-1}$) would have great weight in this instance, and the weighting of later information ($w_k$) would be reduced as the participants would only weight later information highly if it confirmed their initial opinion. This theorising is in line with Asch's (1946) 'directed impression hypothesis', which proposed that later information has less weight as initial evidence sets up an expectancy to which later evidence was interpreted.

These results of the present study did not support research that has found primacy effects for individuals who are less motivated to think (Ahlering & Parker, 1989; Webster, Richter, & Kruglanski, 1996). Interestingly, Petty, Tormala, Hawkins, and Wegener (2001) highlighted differences in empirical findings when levels of motivation to think have been examined. Petty and colleagues stated how, in the impression formation literature, low levels of thinking have been associated with enhanced primacy effects, while high levels of thinking have been associated with enhanced recency effects. However, in persuasion studies, the opposite has been found, with primacy effects displayed by individuals with high motivation to think (e.g. Kassin, Reddy, & Tulloch, 1990; Petty & Wegener, 1994). Petty and Jarvis (1996) have suggested that studies finding primacy under high thinking conditions involved presenting two clear sides to an issue (e.g. prosecution and defence statements; Kassin et al., 1990). It is possible to suggest the evidence used in the present study was viewed as a form of persuasion, with the clips used to persuade participants the target player was a talented player (or not), and that they demonstrated high sporting ability. In these conditions, it is possible thoughtful individuals would form a strong early impression after the initial early evidence which would bias their processing of the secondary evidence (Petty & Wegener, 1998). However, further research is needed to investigate this.

In the SbS judgment condition, those with low motivation to think displayed recency effects. This supports the predictions of Hogarth and Einhorn's (1992) model of recency when SbS processing is required, as later evidence has greater weighting. This suggests the applied implications offered after Study 1 concerning the use of SbS processing should be made with caution, as those with low motivation to think might have their assessments biased by recency effects. Statistically, no significant order effects were displayed by participants with higher motivation to think. However, a visual inspection of Figure 4.4 indicates higher ratings for the declining order compared to the ascending order, thus suggesting a trend to primacy for those with higher motivation to think when using SbS processing. Such a trend would support the previous theorising that participants with higher motivation to think attach greater weight to early evidence, and are more committed to this initial impression.

Experience

It was hypothesised primacy effects would be found in the end-of-sequence (EoS) condition for more experienced participants, but no order effects would occur for less experienced participants. However, primacy effects were observed in the EoS condition regardless of experience. It was also hypothesised that in the step-by-step (SbS) condition, no order effects would be displayed for either level of experience. The results offered some support for the second hypothesis, with more experienced participants displaying no order effects. However, recency effects were displayed by less experienced participants in the SbS condition.

For judgments made in the EoS condition, it was hypothesised primacy effects would be displayed by more experienced participants, but no order effects would occur for less experienced participants. The results only partially supported this hypothesis, with primacy displayed regardless of level of experience. The results support previous research that has found primacy effects when EoS judgments are made (e.g. Jones et al., 1968; Greenlees et al. 2007). Furthermore, the results of the present study support the results from the first study in the present thesis, and add to suggestions previously made that primacy effects are a robust finding when making EoS judgments of ability.

It was hypothesised primacy effects would be offset for less experienced participants in the EoS condition. It was expected they would find information less familiar, and thus use an SbS strategy to deal with the cognitive demands of processing complex information. Hogarth and Einhorn's (1992) model predicts primacy effects will be offset when SbS processing is used. These findings of primacy can be explained by considering the level of SbS processing used, and the impact of this processing on the final judgment. Less experienced participants might have used some SbS processing to assess later evidence. However, it is possible that the anchor created by initial evidence was so strong that although SbS processing of later information did occur, it was insufficiently strong to offset the influence of this anchor. An alternative explanation is the evidence in the present study wasn't of sufficient complexity to force less experienced participants to use an SbS strategy. If the information wasn't complex enough to require additional processing, less experienced participants would have made EoS judgments, thus explaining the primacy effects.

It was hypothesised no order effects would be displayed in the SbS condition. The results only partially supported this hypothesis with more experienced participants displaying no order effects, but recency effects were displayed by less experienced participants. The findings for less experienced participants offer support for previous research that has examined level of experience (e.g. Aldeman, Tolcott, & Bresnick, 1993; Messier & Tubbs, 1994), which has found less experienced individuals show recency effects. The findings offer some support for Hogarth and Einhorn's (1992) model that predicts recency when SbS processing is used. In the higher experience group participants were required to use SbS processing, which explains why later evidence had enough weighting to offset primacy effects. However, it is possible that more experienced participants were more committed to initial judgments, and an SbS strategy only partially offset the weighting of initial evidence. Therefore, as in Study 1, the absence of order effects can be explained by the weight of the initial evidence being offset by the SbS processing of later evidence.

The results of the present study did not replicate the findings of Greenlees et al., (2007) who found experience had no influence on order effects. Greenlees and his colleagues used a basic control and passing skill in soccer as the stimulus material. It is possible all participants found this evidence simple, regardless of their level of soccer experience. Furthermore, soccer is a sport that non-players are still likely to have some experience of watching. Thus, even the non-soccer players might have found the evidence familiar. This could have explained why primacy effects were found regardless of experience.

The task used in the present study involved the target player running towards the disc, catching, pivoting, and making a pass to a second player who was making a run. This task therefore seems more complex than the task in Greenlees et al.'s study. However, it is open to interpretation to whether the task would be considered complex in Hogarth and Einhorn's (1992) model. Indeed, Hogarth and Einhorn (1992) acknowledged the difficulties they had in classifying information as simple or complex. Future research might consider how different levels of task complexity might impact on order effects. For example, footage of 3 different drills at varying degrees of complexity could be used, and the complexity could be a further independent variable in the analysis.

Nevertheless, Greenlees et al. used a sound theoretical rationale to classify participants at different levels of experience. A limitation of the present study was a theoretical rationale was not used to distinguish experienced from non-experienced participants. Instead, a median split was used as an arbitrary figure to create the high and low experienced groups. This is an issue in creating the experience levels, for example, there may only be a limited number of genuinely experienced individuals. Indeed, Hogarth and Einhorn (1992) acknowledged the difficulties they had in classifying information as simple or complex. Although it is beyond the scope of the present thesis, further research should examine what level of experience causes information to be viewed as simple or complex to participants. For example, players or coaches with little experience (e.g. less than one year) and coaches with greater experience (e.g. more than five years) could be used to further examine the influence of experience on order effects.

Taken as they are, the findings of the present study have potential implications for those who make assessments of ability in sport. The results of the present study offer further support to the suggestion that primacy effects bias ability assessments when EoS judgments are made. Furthermore, the results indicate that even if an individual is highly motivated to think, or if they are experienced in the sport, they may still be prone to primacy effects. Further research might examine other variables that could influence whether a participant is prone to primacy or recency in their assessments of ability. In addition, further research should examine judgments made in the EoS condition, and investigate variables that might offset primacy effects in this condition. For example, Luchins (1957) found that inserting an interpolated number task between blocks of information was effective in offsetting primacy effects. In addition, research has found that making participants accountable for their judgements influences order effects (e.g. Cushing & Ahlawat, 1996; Kennedy, 1993; Tetlock, 1983). Thus, future research should examine such conditions that might eliminate primacy effects when end-of-sequence assessments are required.

# CHAPTER 5

## STUDY 3: INVESTIGATING THE INFLUENCE OF ACCOUNTABILITY ON ORDER EFFECTS IN THE END-OF-SEQUENCE JUDGMENT CONDITION

Findings in Studies 1-2 of the present thesis revealed primacy effects in the end-of-sequence (EoS) condition. This has supported the research of Greenlees et al. (2007), who found primacy effects in assessments of sporting ability when EoS judgments were made. Furthermore, these findings are in line with previous research in ability assessments (e.g. Jones et al., 1968; Benassi, 1982). Thus, it appears primacy is a robust finding when participants make one judgment of ability after all evidence has been viewed. This has applied implications in sport, as the evidence suggests people who make assessments of ability may be biased by early information they view. In light of this potential judgment bias, research is needed to explore conditions that might offset primacy. The purpose of the present study was to examine whether increasing levels of accountability for participants who have to make judgments would eliminate primacy effects.

In their study examining personnel decision-making, Highhouse and Gallo (1997) suggested that participants had little risk for making poor decisions. Thus, the presence of order effects was due to participants not being motivated to consider all the evidence. Tetlock (1983) questioned the level of cognitive effort participants exert if they are not personally accountable for their judgments. Subsequently, researchers sought to examine whether making participants accountable for their judgments would eliminate the order effects. Accountability refers to the implicit or explicit expectation that a person has to justify their beliefs, feelings and actions to others (Tetlock, 1992). Research has found that making participants accountable for their judgments decisions has reduced or offset order effects (e.g. Tetlock, 1985; Kennedy, 1993; Cushing & Ahlawat, 1996). For example, Kennedy (1993) manipulated accountability by informing participants that their auditing judgments may be reviewed, with the possibility they might be selected for a conference to explain and justify their responses. The results revealed order effects in the non-accountable condition, however there was no evidence of order effects when participants were told they had to justify their decisions. Kennedy suggested that the judgment bias was due to a lack of effort on behalf of the participants, thus preventing them from accurately processing all the information.

Cushing and Ahlawat (1996) looked to increase accountability for auditors' judgments by asking them to write a document to a senior partner providing reasons to support their opinion. The results supported Kennedy's findings, with order effects offset in the accountability group. Cushing and Ahlawat concurred with Kennedy's explanation for order effects, suggesting that when participants were made accountable for their judgments, greater cognitive effort towards the judgment task occurred, and order effects were eliminated as greater attention was paid to all evidence.

In line with this theorising, it was predicted that increasing levels of accountability for participants' judgments would result in greater cognitive effort exerted towards the ratings task. Thus, the bias produced by overweighting of initial evidence would be offset, as greater attention would be paid to all the evidence, leading to a more accurate and unbiased judgment. Theoretically, this manner of processing is similar to a step-by-step (SbS) strategy, as more accountable participants would pay attention to each piece of evidence, and thus, would be likely to update their judgments sequentially. In light of this, it was hypothesised that no order effects would occur in the accountability manipulation, as the results in Study 1 in the present thesis have shown SbS processing offsets primacy effects and produces no order effects. The present study also contained a control group, in which participants make assessments of ability in an end-of-sequence (EoS) condition with no accountability manipulation. This condition replicates EoS conditions in previous studies that have found a consistent primacy effect, and therefore, it was hypothesised that primacy effects will be displayed in this condition.

*Hypothesis 13*

In the non-accountable condition, primacy effects are predicted.

*Hypothesis 14*

In the accountable condition, no order effects are predicted.

## METHOD

Participants

The participants in this study consisted of 100 club standard ultimate frisbee players (74 male, 26 female), with a mean age of 21.66 years (SD = 2.43 years). Participants' mean playing experience was 2.86 years (SD = 2.01 years). The sample was predominantly white Caucasian ($n$ = 98), with the remainder coming from mixed race ($n$ = 2) backgrounds. All were volunteers and signed informed consent forms prior to participation. The study was carried out in line with University of Chichester's ethics procedures.

Materials

The stimulus used in this experiment was the DVD used in the previous 2 Studies (see page 59 for details on how the footage was recorded and edited).

Measures

*Ratings of the player's ability.* To examine their impressions of the two players observed, participants were asked to rate each player on three factors (ultimate frisbee ability-general, disc control, and speed of thought) that were used in Study 1 and Study 2. Athleticism was measured in the previous two studies but no significant effects were found for this factor. Furthermore, it can be suggested that athleticism is not a measure of ability, but instead a measure of a physical attribute. Therefore, athleticism was removed as a rating measure in this study. Each factor was measured on a 10 point, likert-type scale (e.g., 1 = poor to 10 = excellent).

*Measure of Effort/Accountability.* Participants read and responded to three items as a self-reported measure of effort in the ratings task. The items were "How much effort did you put into watching the clips and providing accurate ratings"; "How motivated were you to perform the ratings task"; and "How carefully did you watch the clips in order to make your judgment". Participants rated their agreement to these statements on a 10-point likert scale. The alpha coefficient for the scale in the present study was 0.85.

Procedure

The data for this Study was collected alongside the data for Study 4. The procedure for the present study was similar to Studies 1-2 in the present thesis, with participants randomly assigned to view either the declining or the ascending order. In addition, participants were also randomly assigned to one of 4 experimental groups; i) a control (non-accountable) group; ii) the accountability group; iii) the interpolated group; and iv) the delay group. In the control group, participants made end-of-sequence judgments with no experimental manipulation (as in Study 1), and these ratings were used in the analyses for both Study 3 and 4. The ratings in the accountable group were also used in the analyses for Study 3. In this accountable condition, participants were asked to consider themselves in the role of a selector for a club side. They were told to watch the footage and make numerical ratings of ability, and also to write a short paragraph to support their ratings. Cushing and Ahlawat (1996) used a similar but more detailed writing process in a study examining order effects in accounting judgments. Cushing and Ahlawat suggested that as participants are being asked to justify their ratings, they become accountable for their judgments. Finally, in the present study, participants were told that the information they provided would be passed on to the target players in the DVD footage as feedback on their performance, in order to help them improve. Thus, referring back to Tetlock's (1992) definition of accountability, this manipulation created a condition that participants had to justify their beliefs, and this information would be passed on to the players in the video footage. All participants in each experimental condition made their ratings of the two target players' ability after all 8 clips had been viewed (end-of-sequence judgments).

Data Analysis

Means, standard deviations, and Pearson correlations for ratings of the control and target players are presented in Table 5.1. Pearson product-moment correlations were conducted on the dependent variables to assess the data for multi-collinearity, and indicated low correlations for the control player. Due to these low correlations, it was decided to analyse the three dependent variables (ultimate ability, disc control, speed of thought) separately, instead of combining them into one construct as in Studies 1 and 2.

Two-way univariate analyses of covariance (ANCOVAs) were conducted on the ratings of the target player to examine the interaction between order of presentation and experimental condition. The scores of the control player were used as a covariate to control for any differences in rating scores when viewing identical footage. Before conducting the analysis, the data was examined to determine if it satisfied the assumptions of ANCOVA (Pallant, 2001). Independent sample t-tests were used when

| Variable | M | SD | Subscale | | |
|---|---|---|---|---|---|
| | | | 1 | 2 | 3 |
| Control ratings ($n$ = 100) | | | | | |
| 1. Ultimate Frisbee Ability | 6.55 | 1.00 | - | .64(**) | .30(**) |
| 2. Disc Control | 6.70 | 1.08 | | - | .23(**) |
| 3. Speed of Thought | 6.57 | 1.06 | | | - |
| | | | | | |
| Target ratings ($n$ = 100) | | | | | |
| 1. Ultimate Frisbee Ability | 5.40 | 1.23 | - | .74(**) | .71(**) |
| 2. Disc Control | 5.30 | 1.30 | | - | .69(**) |
| 4. Speed of Thought | 5.51 | 1.37 | | | |

**$p<.01$

*Table 5.1. Rating means, standard deviations, and intercorrelations between subscales*

necessary to evaluate main effects, using a change value to control for the score of the covariate. Alpha was set at $P = 0.05$ for all statistical analyses. The written paragraphs (in the accountability condition) were not analysed as they were used only as part of the accountability manipulation.

## RESULTS

Impact of order and accountability condition on ratings of the target player

The test of equality of regression slopes revealed this assumption was not violated. In addition, Levene's test was not statistically significant for either of the covariates, therefore the assumption of homogeneity of variance was satisfied.

The 2 (declining vs. ascending order) x 2 (non-accountable vs. accountable experimental condition) ANCOVA, conducted on the ratings of 'Ultimate Frisbee ability (general)' revealed a significant main effect for order ($F_{1,95} = 9.50$, $p < .01$, effect size $\eta^2 = .10$, estimated power at 5% probability = .862). However, the results revealed no significant main effect for experimental condition ($F_{1,95} = .31$, $p > .05$, effect size $\eta^2 < .01$, estimated power at 5% probability = .09). In addition, no significant order by experimental condition interaction effect was observed ($F_{1,95} = .37$, $p > .05$, effect size $\eta^2 < .01$, estimated power at 5% probability = .06). Thus, the main effect for order revealed a primacy effect regardless of the accountability condition for the ratings of Ultimate Frisbee ability (general). This main effect is illustrated in Figure 5.1.

The 2 (declining vs. ascending order) x 2 (non-accountable vs. accountable experimental condition) ANCOVA, conducted on the ratings of 'disc control' revealed a significant main effect for order ($F_{1,95} = 18.78$, $p < .01$, effect size $\eta^2 = .17$, estimated power at 5% probability = .99). However, the results revealed no significant main effect for experimental condition ($F_{1,95} = 1.24$, $p > .05$, effect size $\eta^2 = .01$, estimated power at 5% probability = .20). In addition, no significant order by experimental condition interaction effect was observed ($F_{1,95} = .02$, $p > .05$, effect size $\eta^2 < .01$, estimated power at 5% probability = .05). Thus, the main effect for order revealed a primacy effect

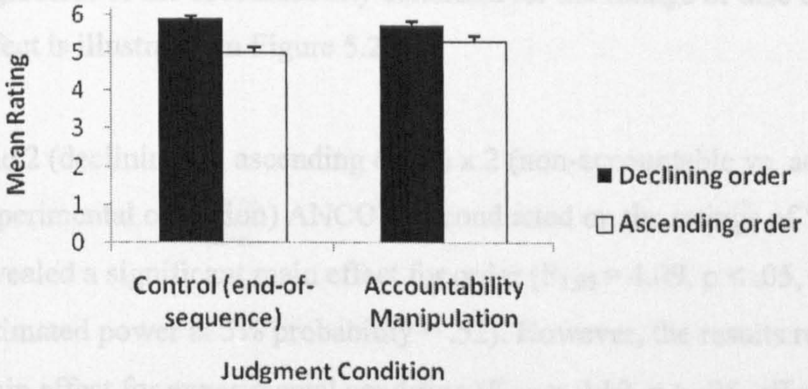



*Figure 5.1. Mean (+SE) ratings for 'ultimate Frisbee ability (general)' for the control (end-of-sequence) and accountability manipulation conditions in descending and ascending orders of information.*

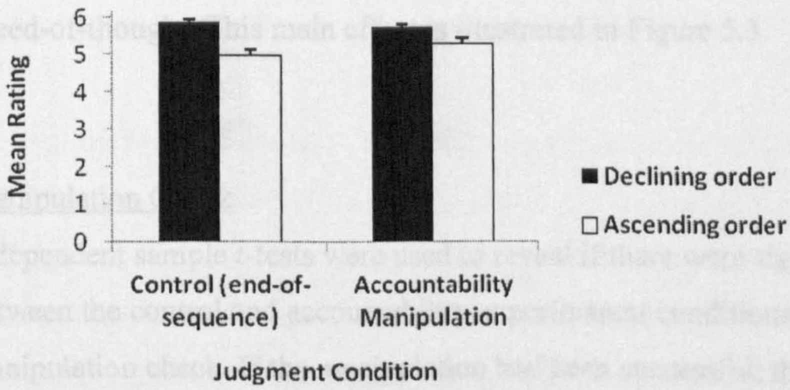



*Figure 5.2. Mean (+SE) ratings for 'disc control' for the control (end-of-sequence) and accountability manipulation conditions in descending and ascending orders of information.*

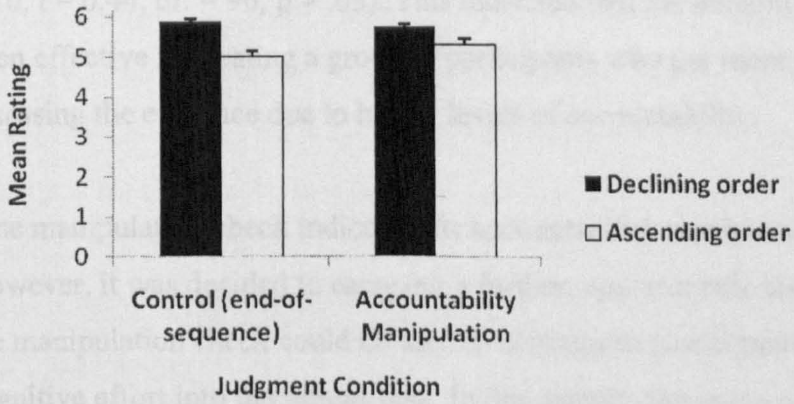



*Figure 5.3. Mean (+SE) ratings for 'speed-of-thought' for the control (end-of-sequence) and accountability manipulation conditions in descending and ascending orders of information.*

regardless of the accountability condition for the ratings of disc control. This main effect is illustrated in Figure 5.2.

The 2 (declining vs. ascending order) x 2 (non-accountable vs. accountable experimental condition) ANCOVA, conducted on the ratings of 'speed-of-thought' revealed a significant main effect for order ($F_{1,95} = 4.09$, $p < .05$, effect size $\eta^2 = .04$, estimated power at 5% probability = .52). However, the results revealed no significant main effect for experimental condition ($F_{1,95} = 0.19$, $p > .05$, effect size $\eta^2 < .01$, estimated power at 5% probability = .07). In addition, no significant order by experimental condition interaction effect was observed ($F_{1,95} = .89$, $p > .05$, effect size $\eta^2 < .01$, estimated power at 5% probability = .16). Thus, the main effect for order revealed a primacy effect regardless of the accountability condition for the ratings of speed-of-thought. This main effect is illustrated in Figure 5.3.

## Manipulation Check

Independent sample t-tests were used to reveal if there were significant differences between the control and accountability experimental conditions with regards to the manipulation check. If the manipulation had been successful, the accountability group would be expected to show higher effort and motivation levels in completing the ratings task on the self-reported manipulation check. However, the t-tests revealed no significant difference between the accountability and control group (mean difference = 0.10, $t = 0.44$, df. = 96, $p > .05$). This indicated that the manipulation check had not been effective in creating a group of participants who put more cognitive effort into assessing the evidence due to higher levels of accountability.

The manipulation check indicated the accountability manipulation was unsuccessful. However, it was decided to carry out a further, opportunistic analysis, as the data from the manipulation check could be used to distinguish participants who put greater cognitive effort into the ratings task. In this sample, the range of average scores for the manipulation check was 5.33 to 10, with a median score of 8.24, and this median split created the high and low cognitive effort groups. An independent sample t-test revealed the mean score ($M = 8.92$, $SD = .58$) for the high cognitive effort group was significantly higher than the mean score ($M = 7.16$, $SD = .74$) for the low cognitive effort group (mean difference = 1.76, $t = 13.01$, df. = 94, $P < .001$).

Following the median split, three further 2 (declining vs. ascending order) x 2 (high vs. low cognitive effort) ANCOVAs were conducted on the ratings of the target player for each of the three dependent variables. The ratings for 'Ultimate Frisbee ability (General)' revealed a significant main effect for order ($F_{1,95} = 9.40$, $p < .01$, effect size $\eta^2 = .09$, estimated power at 5% probability = .86). This main effect is illustrated in Figure 5.4. However, the results revealed no significant main effect for level of cognitive effort ($F_{1,95} = .13$, $p > .05$, effect size $\eta^2 < .01$, estimated power at 5% probability = .07). In addition, no significant order by cognitive effort interaction effect was observed ($F_{1,95} = .84$, $p > .05$, effect size $\eta^2 = .01$, estimated power at 5% probability = .15).

The ratings for 'disc control' revealed a significant main effect for order ($F_{1,95} = 17.38$, $p < .01$, effect size $\eta^2 = .16$, estimated power at 5% probability = .99). This main effect is illustrated in Figure 5.5. However, the results revealed no significant main effect for level of cognitive effort ($F_{1,95} = 1.24$, $p > .05$, effect size $\eta^2 < .01$, estimated power at 5% probability = .09). In addition, no significant order by cognitive effort interaction effect was observed ($F_{1,95} = 1.76$, $p > .05$, effect size $\eta^2 = .02$, estimated power at 5% probability = .26).

The ratings for 'speed-of-thought' revealed a significant main effect for order ($F_{1,95} = 4.61$, $p < .05$, effect size $\eta^2 = .06$, estimated power at 5% probability = .47). This main effect is illustrated in Figure 5.6. However, the results revealed no significant main effect for level of cognitive effort ($F_{1,95} = 0.19$, $p > .05$, effect size $\eta^2 < .01$, estimated power at 5% probability = .07). In addition, no significant order by cognitive effort interaction effect was observed ($F_{1,95} = .37$, $p > .05$, effect size $\eta^2 < .01$, estimated power at 5% probability = .09).

In summary, the main effect for order for the ratings of each of the three dependent variables revealed a primacy effect regardless of the level of cognitive effort participants showed in the assessment task.

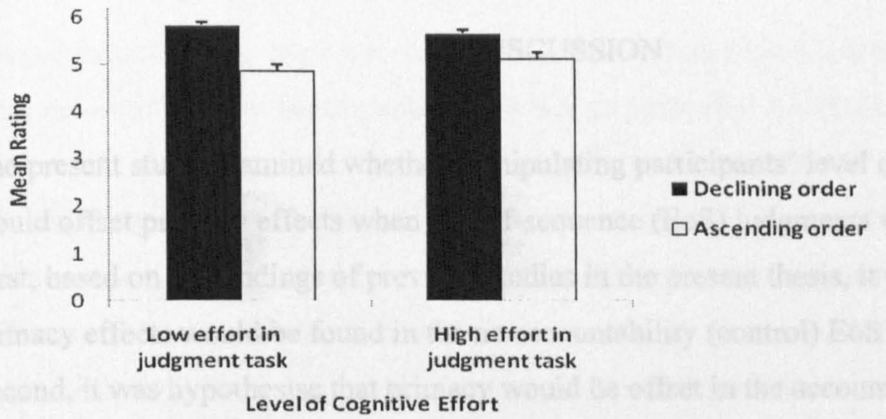



*Figure 5.4. Mean (+SE) ratings for 'ultimate Frisbee ability (general)' for the control (end-of-sequence) and levels of cognitive effort in descending and ascending orders of information.*

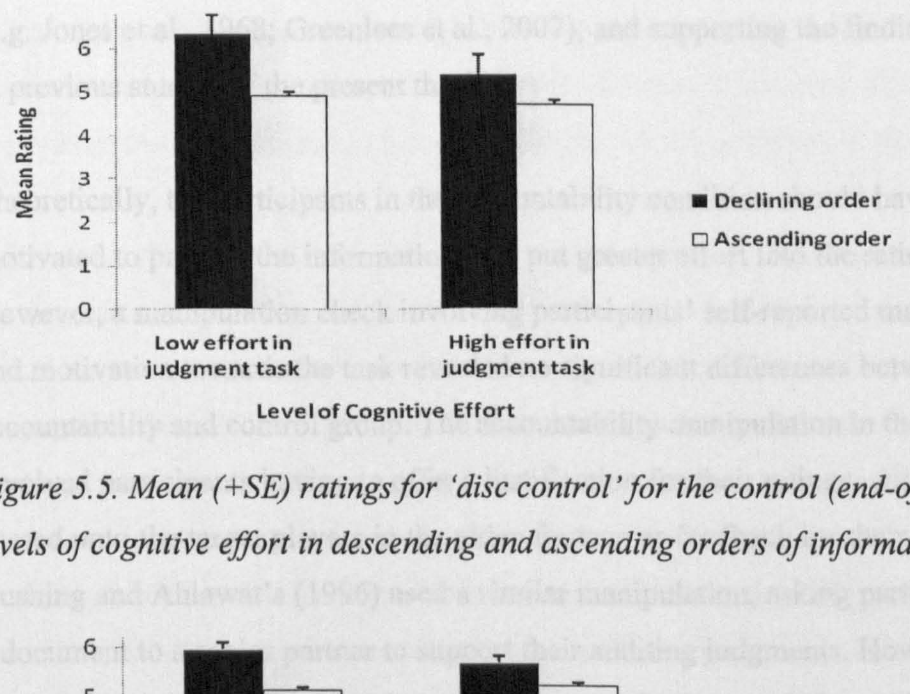



*Figure 5.5. Mean (+SE) ratings for 'disc control' for the control (end-of-sequence) and levels of cognitive effort in descending and ascending orders of information.*

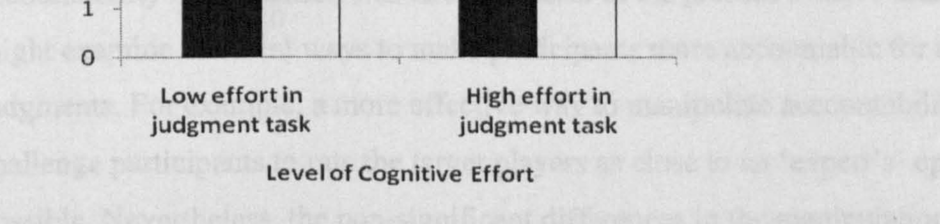



*Figure 5.6. Mean (+SE) ratings for 'speed-of-thought' for the control (end-of-sequence) and levels of cognitive effort in descending and ascending orders of information.*

# DISCUSSION

The present study examined whether manipulating participants' level of accountability would offset primacy effects when end-of-sequence (EoS) judgments were required. First, based on the findings of previous studies in the present thesis, it was hypothesised primacy effects would be found in the no accountability (control) EoS condition. Second, it was hypothesise that primacy would be offset in the accountability condition. However, the results failed to support the second hypothesis, with primacy effects observed in both experimental conditions for each of the three dependent variables. These findings of primacy offer further support to the contention that primacy is a robust finding when EoS assessments of ability are made, supporting previous research (e.g. Jones et al., 1968; Greenlees et al., 2007), and supporting the findings of primacy in previous studies of the present thesis.

Theoretically, the participants in the accountability condition should have been more motivated to process the information, and put greater effort into the ratings task. However, a manipulation check involving participants' self-reported measures of effort and motivation towards the task revealed no significant differences between the accountability and control group. The accountability manipulation in the present study involved participants having to offer a justification for their ratings, with information passed onto the target players in the video footage as feedback for their performance. Cushing and Ahlawat's (1996) used a similar manipulation, asking participants to write a document to a senior partner to support their auditing judgments. However, participants in Cushing and Ahlawat's study thought they could be made directly accountable for their judgments, whereas, participants in the present study knew they would not have to directly defend their opinions to anyone. This might explain why the accountability manipulation was not successful in the present study. Future research might examine different ways to make participants more accountable for their judgments. For example, a more effective way to manipulate accountability might be to challenge participants to rate the target players as close to an 'expert's' opinion as possible. Nevertheless, the non-significant differences in the manipulation check indicated that we were unsuccessful in creating a higher level of accountability, and thus, questioned the findings that primacy occurs regardless of level of accountability.

When conducting quantitative research, a methodological issue is getting a full and accurate response from participants. In the present study, the researcher had little difficulty in recruiting participants to complete the assessment task. Participants belonged to a select group (ultimate frisbee players) and as the purpose of the research was explained, participants were more likely to identify with the goals of the research and thus have a certain level of motivation to participate (Frankfort-Nachmias & Nachmias, 1996). However, within this sample, it is still possible that participants would vary in the levels of cognitive effort they exerted towards the ratings task. Indeed, the manipulation check provided evidence that participants' levels of effort and motivation was variable, and this data could be used to distinguish participants who put greater cognitive effort into the ratings task. Thus, a further analysis was carried out using a median split to create the high and low cognitive effort group. The purpose of this further analysis was to examine whether self-reported levels of effort and motivation towards the ratings task would impact on order effects in the EoS condition.

In line with Hogarth and Einhorn's (1992) belief adjustment model, it was expected that participants who reported low levels of cognitive effort would display primacy effects. It was also expected that primacy effects would be offset for those who reported high cognitive effort, as increased effort would be expected to result in an SbS processing strategy, and in the present thesis, SbS processing has been shown to offset primacy. However, findings revealed significant primacy effects, regardless of the level of self-reported cognitive effort, and therefore did not offer support for Hogarth and Einhorn's theorising. These results support the findings of Study 2, in which participants with high motivation to think displaying primacy effects in the EoS condition. Similar theoretical explanations can be offered for why primacy effects are also displayed in the present study even when participants report higher cognitive effort or motivation towards the task. The most plausible explanation is that some SbS processing did occur, but this processing of later evidence only created weak weighting of later evidence in comparison to the initial anchor. Thus, even though participants increased their cognitive effort towards the task, primacy effects still emerged.

The findings of the present study have implications for coaches and others who assess ability in sport. The primacy bias in impressions of sporting ability that has been a consistent finding in the present thesis has emerged in the present study regardless of the accountability manipulation, and regardless of levels of cognitive effort participants showed towards the ratings task. The results suggest that even the ability assessments of those who are motivated to process all information, and who exert high levels of effort to process information may still be affected by primacy effects. Further research might examine other experimental manipulations that might offset the primacy bias in the end-of-sequence condition.

# CHAPTER 6

## STUDY 4: INVESTIGATING THE INFLUENCE OF AN INTERPOLATED TASK ON ORDER EFFECTS IN THE END-OF-SEQUENCE JUDGMENT CONDITION

Findings in Studies 1-3 of the present thesis have revealed consistent primacy effects in the end-of-sequence (EoS) condition. This has supported the research of Greenlees et al. (2007), who found primacy effects in assessments of sporting ability when EoS judgments were made. Furthermore, these findings are in line with previous research in ability assessments (e.g. Jones et al., 1968; Benassi, 1982). Thus, it appears that primacy is a robust finding when participants make one judgment of ability after all evidence has been viewed. In light of these findings, the purpose of the present study was to consider the impact of an interpolated activity inserted between viewing footage of the target player, and whether this variable would offset primacy in the EoS condition. In addition, step-by-step (SbS) methods have been shown to offset primacy effects in Studies 1 and 2, which led to applied suggestions being made to coaches about using SbS procedures in their ability assessments in order to offset primacy. However, in reality, this may be impractical for coaches to implement. If coaches used SbS methods to assess a large group, for example at a trial, the process would be long-winded and time consuming. Thus, a further purpose of the present study was to investigate other methods to offset primacy in the EoS condition, which might be more practical than developing SbS methods.

Hogarth and Einhorn's (1992) belief-adjustment model predicts primacy effects in the EoS condition. This prediction is backed up by the majority of studies (e.g. Asch, 1948; Anderson & Barrios, 1961) that have shown primacy in EoS conditions. However, Hogarth and Einhorn highlight how EoS studies that failed to show primacy, or resulted in recency, involved certain experimental manipulations. Such manipulations included asking participants to recall information (e.g. Anderson & Hubert, 1963), having another task interpolated between evidence (e.g. Luchins, 1957), and including a time delay (e.g. Miller & Campbell, 1959). Hogarth and Einhorn speculated these manipulations affected the judgment process, thus offsetting the primacy effects usually found in the EoS condition. The present study examined the impact of an interpolated activity on order effects, as coaches might have to carry out other tasks between assessing players. A sport-specific task was used an interpolated activity, which participants completed half way through the 8 clips of evidence they viewed.

Luchins (1957) investigated order effects in an impression formation task, through presenting participants with written paragraphs describing a target person. Luchins manipulated the order in which these descriptions were presented to participants, and found evidence of primacy effects in judgments concerning the target person. In follow up experiments, Luchins investigated variables that might offset the primacy effects found. These variables included the use of an interpolated warning, and an interpolated number task, which were both given in between information concerning the target person. Luchins found both interpolated tasks eliminated the primacy effects, and produced a move to recency. Luchins hypothesised the interpolated tasks created a break between the blocks of information, thus preventing the information being assessed as a continuous unit, and allowing more attention to be paid to later evidence. Thus, the greater weighting of later evidence explains the move away from primacy and towards recency.

Hoch (1984) investigated the cognitive processes underlying predictive judgments by using a hypothesis-generation task (e.g. asking participants to give reasons for and against purchasing a video recorder). The results of the first two experiments showed evidence of primacy effects, with probability estimates (e.g. of purchasing the video recorder) more influenced by whichever side of the argument participants thought of first. In the third experiment, Hoch introduced a three minute interpolated task between the generation of different sides to the arguments. This task involved rating the similarity of 10 different domestic beers. The results showed an absence of order effects in this condition. Hoch reasoned that the delay caused by the interpolated activity meant greater attention could be paid to the second set of reasons, without the interference of the first set of the reasons.

Although, their model predicts primacy in the EoS condition, Hogarth and Einhorn (1992) suggested that interpolated tasks are one experimental manipulation that can offset primacy. Previous researchers (Luchins, 1957; Hoch, 1984) have proposed a move away from primacy and towards recency when interpolated tasks have been used. In line with Hogarth and Einhorn's theorising, interpolated tasks might cause later evidence to have greater weighting. Therefore, it was hypothesised that the interpolated activity would offset primacy, and thus, no order effects were hypothesised in the interpolated condition.

*Hypothesis 15*

In the interpolated condition, no order effects are predicted.

## METHOD

### Participants

The participants in this study consisted of 150 club standard ultimate frisbee players (121 male, 29 female), with a mean age of 21.44 years (SD = 2.98 years). Participants' mean playing experience was 2.92 years (SD = 2.09 years). The sample was predominantly white Caucasian (*n* = 145), with the remainder coming from Asian (*n* = 3) and mixed race (*n* = 2) backgrounds. All were volunteers and signed informed consent forms prior to participation. The study was approved by the Ethics Committee at the University of Chichester.

### Materials

The stimulus used in this experiment was the DVD used in the previous 3 Studies (see page 59) for details on how the footage was recorded and edited).

### Measures

*Ratings of the player's ability.* To examine their impressions of the two players observed, participants were asked to rate each player on the same three factors (ultimate frisbee ability-general, disc control, and speed of thought) used in Studies 3-5. Each factor was measured on a 10 point, likert-type scale (e.g., 1 = poor to 10 = excellent).

### Procedure

The procedure for the present study was similar to previous studies, apart from the addition of an interpolated condition. Participants were randomly assigned to view either the declining or the ascending order of information. The data collection for this study was conducted alongside the data collection for Study 3. Thus, participants were also assigned to either i) the end-of-sequence (EoS) response group; ii) the accountability manipulation group; iii) an interpolated condition; or iii) a delay condition. Due to the time taken to complete the interpolated task, the delay experimental condition was operationalised to control for this time delay. Participants in the delay condition were informed they would watch the first four clips of the target player, then there would be a 60-second delay, after which they would watch the second four clips. In the delay condition, the researcher manually paused the DVD for 60 seconds after the first four clips of the target player had been viewed. All participants in each condition made their judgments of the two players after all 8 clips had been viewed.

In the interpolated condition, participants were informed they would watch the first four clips of the target player, and then complete an interpolated task. Following the task, participants would watch the second four clips, and then make their overall assessments of the target player's ability. The interpolated activity was completed after 4 pieces of evidence which split the 8 pieces of evidence into two equal blocks. This approach most closely replicated Luchins' (1957) study, in which the interpolated task was completed between two blocks of information. The task involved designing a zone system to use as a defensive strategy in windy conditions (see Appendix 5.1). This task was used as it was specific to ultimate frisbee players and could be completed in the time frame (60 seconds). In the interpolated condition, the researcher manually paused the DVD after four clips to allow participants to carry out the interpolated task.

Data Analysis

Means, standard deviations, and Pearson correlations for ratings of the control and target players are presented in Table 6.1. Pearson product-moment correlations were conducted on the dependent variables to assess the data for multi-collinearity, and indicated low correlations for the control player. Due to these low correlations, it was again decided to analyse the three dependent variables (ultimate ability, disc control, speed of thought) separately.

| Variable | M | SD | Subscale | | |
|---|---|---|---|---|---|
| | | | 1 | 2 | 3 |
| Control ratings ($n$ = 150) | | | | | |
| 1. Ultimate Frisbee Ability | 6.62 | 0.96 | - | .58(**) | .48(**) |
| 2. Disc Control | 6.58 | 1.08 | | - | .36(**) |
| 3. Speed of Thought | 6.39 | 1.15 | | | - |
| | | | | | |
| Target ratings ($n$ = 150) | | | | | |
| 1. Ultimate Frisbee Ability | 5.55 | 1.29 | - | .79(**) | .76(**) |
| 2. Disc Control | 5.35 | 1.38 | | - | .69(**) |
| 4. Speed of Thought | 5.58 | 1.39 | | | |

**$p<.01$

*Table 6.1. Rating means, standard deviations, and intercorrelations between subscales*

2 x 3 (order x experimental condition) analyses of covariance (ANCOVAs) were conducted on the ratings of the target player. The scores of the control player were used as a covariate to control for any differences in rating scores when viewing identical footage. Before conducting the analyses, the data was examined to determine if it satisfied the assumptions of ANCOVA (Pallant, 2001). Independent sample t-tests were used when necessary to evaluate main effects, using a change value to control for the score of the covariate. Alpha was set at P = 0.05 for all statistical analyses.

## RESULTS

Impact of order and judgement mode on ratings of the target player

The test of equality of regression slopes revealed this assumption was not violated for any of the three dependent variables. In addition, Levene's test was not statistically significant for either of the covariates, therefore the assumption of homogeneity of variance was satisfied for each of the variables.

The 2 (declining vs. ascending order) x 3 (EoS vs. Interpolated vs. Delay experimental condition) ANCOVA for the ratings of 'ultimate Frisbee ability(general)' revealed a significant order by condition interaction effect ($F_{2,143} = 9.71$, $p < .001$, effect size $\eta^2 = .12$, estimated power at 5% probability = .98). However, the results revealed no significant main effects for order ($F_{1,143} = .49$, $p > .05$, effect size $\eta^2 = .03$, estimated power at 5% probability = .11), or experimental condition ($F_{2,143} = 1.30$, $p > .05$, effect size $\eta^2 = .02$, estimated power at 5% probability = .28).

Independent sample t-tests for the ratings of 'ultimate Frisbee ability (general)' revealed in the EoS (control) condition, participants viewing the declining order rated the target player significantly higher than participants viewing the ascending order (mean difference = .72, t = 2.11, df. = 48, p < .05). In the interpolated condition, these findings were reversed, with participants who viewed the declining order rating the target player significantly lower than participants who viewed the ascending order (mean difference = -1.20, t = -3.30, df. = 48, p < .01). There was no significant difference between ratings of the declining and ascending orders in the delay condition (mean difference = .04, t = .12, df. = 48, p > .05). This indicated no order effects were seen in the delay condition. These findings are illustrated in Figure 6.1.

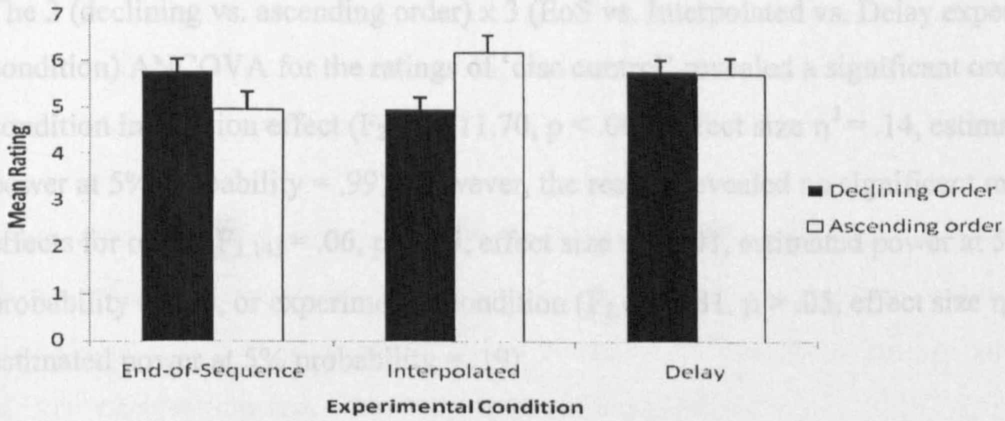



*Figure 6.1. Mean (+SE) ratings for 'ultimate Frisbee ability (general)' for end-of-sequence, interpolated and delay conditions for the declining and ascending orders of information.*

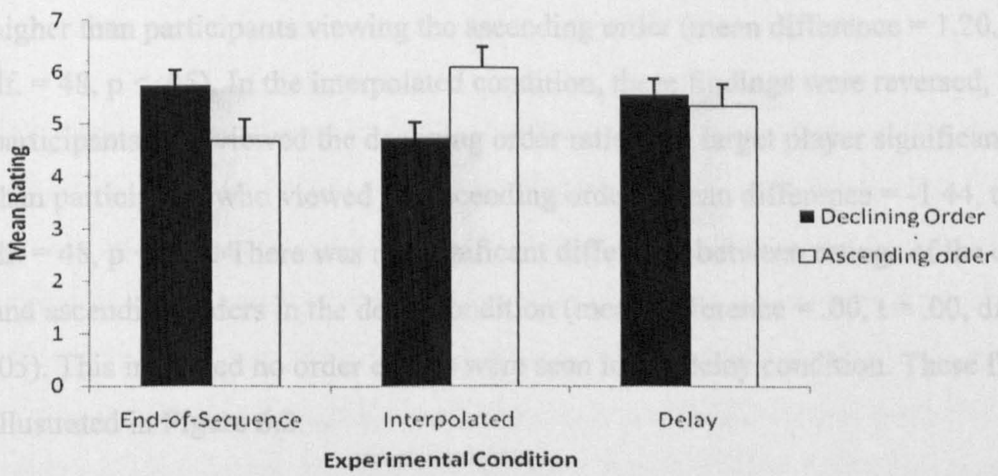



*Figure 6.2. Mean (+SE) ratings for 'disc control' for end-of-sequence, interpolated and delay conditions for the declining and ascending orders of information.*

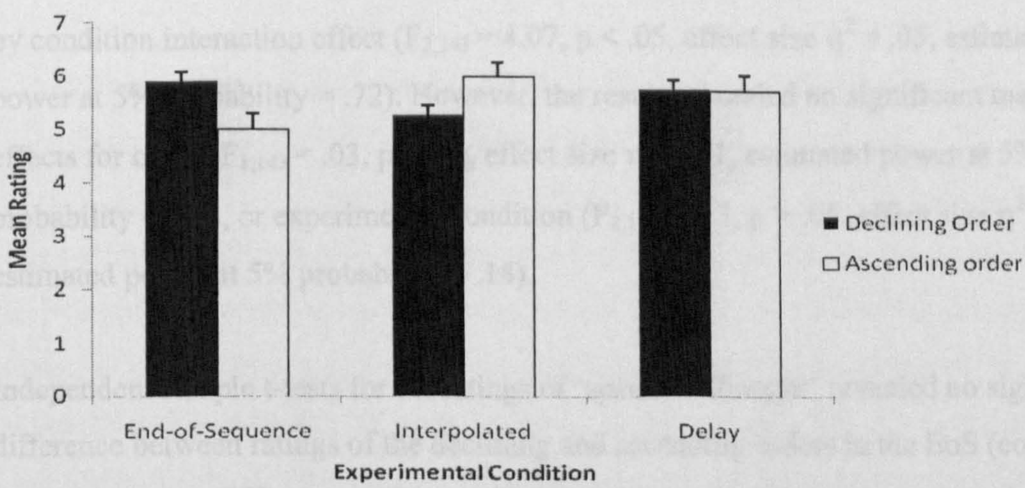



*Figure 6.3. Mean (+SE) ratings for 'speed-of-thought' for end-of-sequence, interpolated and delay conditions for the declining and ascending orders of information.*

The 2 (declining vs. ascending order) x 3 (EoS vs. Interpolated vs. Delay experimental condition) ANCOVA for the ratings of 'disc control' revealed a significant order by condition interaction effect ($F_{2,143} = 11.70$, $p < .001$, effect size $\eta^2 = .14$, estimated power at 5% probability = .99). However, the results revealed no significant main effects for order ($F_{1,143} = .06$, $p > .05$, effect size $\eta^2 < .01$, estimated power at 5% probability = .06), or experimental condition ($F_{2,143} = .81$, $p > .05$, effect size $\eta^2 = .01$, estimated power at 5% probability = .19).

Independent sample t-tests for the ratings of 'disc control' revealed in the EoS (control) condition, participants viewing the declining order rated the target player significantly higher than participants viewing the ascending order (mean difference = 1.20, t = 2.59, df. = 48, $p < .05$). In the interpolated condition, these findings were reversed, with participants who viewed the declining order rating the target player significantly lower than participants who viewed the ascending order (mean difference = -1.44, t = -3.86, df. = 48, $p < .01$). There was no significant difference between ratings of the declining and ascending orders in the delay condition (mean difference = .00, t = .00, df. = 48, $p > .05$). This indicated no order effects were seen in the delay condition. These findings are illustrated in Figure 6.2.

The 2 (declining vs. ascending order) x 3 (EoS vs. Interpolated vs. Delay experimental condition) ANCOVA for the ratings of 'speed-of-thought' revealed a significant order by condition interaction effect ($F_{2,143} = 4.07$, $p < .05$, effect size $\eta^2 = .05$, estimated power at 5% probability = .72). However, the results revealed no significant main effects for order ($F_{1,143} = .03$, $p > .05$, effect size $\eta^2 < .01$, estimated power at 5% probability = .05), or experimental condition ($F_{2,143} = .53$, $p > .05$, effect size $\eta^2 = .01$, estimated power at 5% probability = .14).

Independent sample t-tests for the ratings of 'speed-of-thought' revealed no significant difference between ratings of the declining and ascending orders in the EoS (control) condition (mean difference = .24, t = .50, df. = 48, $p > .05$). In the interpolated condition, participants who viewed the declining order rating the target player significantly lower than participants who viewed the ascending order (mean difference = -1.04, t = -2.19, df. = 48, $p < .05$). There was no significant difference between ratings of the declining and ascending orders in the delay condition (mean difference = .20, t = .40, df. = 48, $p > .05$). This indicated no order effects were seen in the delay condition. These findings are illustrated in Figure 6.3.

In summary, primacy effects were seen in the EoS condition for the ratings of ultimate frisbee ability (General) and disc control. In the interpolated condition, recency effects were seen for each of the three dependent variables. In the delay condition, no order effects were seen for any of the three dependent variables.

## DISCUSSION

The purpose of the present study was to investigate whether an experimental manipulation would influence the order effects that have been a consistent finding in the end-of-sequence (EoS) condition in Studies 1-3. More specifically, the present study examined whether an interpolated activity inserted between clips of information would offset primacy effects in the EoS condition. It was hypothesised that the interpolated activity would offset the primacy effects, and no order effects were predicted to occur in this condition. The results of the present study failed to fully support this hypothesis, as recency effects were observed in the interpolated condition for each of the three dependent variables.

The findings again revealed primacy effects in the EoS condition. Relating this back to Hogarth and Einhorn's (1992) algebraic equation in the EoS mode - $S_k = S(x_1) + w_k[s(x_2, \ldots\ldots, x_k) - R]$, primacy effects are predicted as the initial evidence $S(x_1)$ forms a strong anchor, and the remaining evidence $s(x_2, \ldots\ldots, x_k)$ is aggregated. As the interpolated condition has eliminated primacy effects, and produced recency effects, it appears that the interpolated condition has both reduced the weighting of the initial anchor $[S(x_1)]$, and also caused later evidence to have increased weighting on the final impression. Luchins (1957) suggested that impact of the interpolated tasks created a break between the blocks of information, consequently making it less likely information was perceived as a homogeneous unit. Thus, it appears the interpolated manipulation meant the evidence following the anchor wasn't just aggregated due to the break between blocks of evidence. Thus, the interpolated activity most likely meant a standard

EoS response was not made, and consequently, primacy didn't emerge. However, this fails to explain why recency occurred in the interpolated condition.

Miller and Campbell (1959) proposed primacy effects were offset by a time delay placed between blocks of information. Miller and Campbell suggested recency effects emerged due to more recent information having a stronger presence in the short-term memory. In the present study, a further experimental condition was operationalised to control for the time delay created by carrying out the interpolated activity. In this delay condition, for each of the three dependent variables, no order effects were displayed. Thus, the results indicated that a time delay (of 60 seconds) offset primacy effects, whereas the interpolated condition produced recency effects.

It is apparent that both the delay and the interpolated conditions resulted in greater weighting being placed on later evidence compared to the weighting of the initial anchor. This might be due to the explanations of Miller and Campbell (1959) who suggested a time delay results in later evidence having a stronger presence in the short-term memory. The differing order effects that occurred in the interpolated and delay conditions are likely explained by the level of processing that resulted in each experimental condition. With the delay creating a break between the two blocks of evidence, Hogarth and Einhorn's (1992) algebraic equation can be adjusted to explain how the end judgment ($S_k$) was arrived at in light of processing the eight pieces of information.

$$S_k = w_k[s(x_1 + x_2 + x_3 + x_4)/4 - R] + w_k[s(x_5 + x_6 + x_7 + x_8)/4 - R]\}$$

In the interpolated condition, it is unlikely the first four pieces of information were processed fully, as the interpolated task would take up cognitive resources. Consequently, with less active processing of early evidence, it is possible that early evidence had less weighting ($w_k$) and thus less influence on the overall impression in the interpolated condition, compared to the greater weighting of later information, which resulted in recency effects. In contrast, it is likely the time delay in the delay condition allowed more active processing of the first four pieces of evidence. Thus, the weighting of the first half of evidence was higher in the delay condition compared to the interpolated condition. In the delay condition therefore, the early evidence had a more equal weighting on the overall impression, and this would explain why no order effects occurred. Further research would be needed concerning the processing strategies used in the delay condition before such a proposal can be substantiated.

The purpose of the present study was to investigate whether an interpolated activity was an experimental manipulation that would reduce order effects. The results revealed the primacy bias which has been a consistent finding in the end-of-sequence (EoS) condition is replaced by a recency bias in the interpolated condition. The findings of the present study have implications for coaches and others who assess ability in sport. Thus, if someone assessing players in sport is distracted by another task during observing players at a trial, the player who starts well but declines in performance (e.g. loses focus, concentration, gets tired, has an injury) will be judged unfavourably compared to a player who starts poorly, but improves and finishes well. As the present study found that an interpolated task failed to eliminate order effects, future research might examine other experimental manipulations that might offset order effects in the EoS condition.

However, in the delay condition used to control for the time delay created by the interpolated activity, primacy effects were eliminated, and no order effects occurred. These findings also have applied implications for those who assess ability in sport. The results indicate that if there is a break between viewing information, this is likely to produce additional processing of information which might eliminate the primacy bias, creating a form of SbS processing. Indeed, this is comparable to the findings in Study 1 that showed SbS processing after each piece of information to offset order effects. In effect, the time delay in the present study allowed a form of SbS processing to take place, with evidence actively processed after half the clips and then again after all the clips.

# CHAPTER 9

# GENERAL DISCUSSIONS AND CONCLUSIONS

The aim of this thesis was to extend the work of Greenlees et al. (2007) through a more systematic examination of order effects in assessments of sporting ability. Within the social psychology literature, many errors have been identified when social judgments of others are made (Funder, 2003). The order effect is one such phenomenon that has been shown to bias social judgments. If judgments of sport performances follows the general principles of social judgments (Plessner & Haar, 2006), then it would be expected that order effects might bias sporting judgments, and the results of Greenlees et al. provided initial evidence of order effects in sport. The present thesis therefore sought to provide a more thorough test of the incidence of order effects in sporting judgments. Hogarth and Einhorn's (1992) belief-adjustment model provided a theoretical underpinning for the thesis, and the programme of studies tested the predictions of the model in a sporting domain. In addition, the present thesis sought to replicate and extend the research of Greenlees et al. in a different sport setting. Thus, the present thesis makes three specific contributions to the order effects literature in assessments of sporting ability. First, Study 1 provided a more thorough examination of the impact of step-by-step processing on order effects in assessments of sporting ability. Second, Study 2 investigated the influence of various moderating variables on the incidence of order effects. Third, Studies 3-4 have examined the impact of certain experimental conditions on order effects in the end-of-sequence condition.

The aim of this chapter is to provide a summary of the findings from this programme of research. Furthermore, this chapter provides a discussion of the findings in light of previous theory and research, and considers the implications of these findings for those who make assessments of ability in sport. In addition, a further aim of this chapter is to make recommendations concerning the direction of future research into order effects.

## SUMMARY OF FINDINGS

### *End-of-sequence (EoS) judgments*

A key finding of the research was the consistency with which primacy effects occurred when end-of-sequence (EoS) assessments were required. In Study 1, significant primacy effects emerged in the EoS condition. In Study 2, participants who were classified as having higher motivation to think showed primacy effects in the EoS condition, and primacy effects were displayed regardless of theory of learning beliefs. Also in Study 2, primacy effects emerged in the EoS condition for both high and low levels of experience, which supported findings of Greenlees et al. (2007) who found primacy effects regardless of levels of experience. In Study 3, primacy effects were displayed by participants, regardless of their levels of accountability. These consistent findings of primacy in the EoS condition provided strong evidence that primacy effects occur when EoS assessments of sporting ability are used. Furthermore, from this finding, it can be proposed that primacy effects may be common in sporting contexts. These findings also support previous research that has found primacy effects when ability has been assessed (Jones et al., 1968; Newtson & Rindner, 1979; McAndrew, 1981; Benassi, 1982).

It is proposed (Hogarth & Einhorn, 1992) that primacy effects occur when EoS assessments are made, as there is greater weighting of earlier information on the overall judgment compared to the weighting of later information, which has less weighting on the end judgment. However, the precise reasons for the primacy bias are unclear. Hogarth and Einhorn (1992) propose that the first piece of evidence viewed creates an anchor, and then the remaining pieces of evidence are aggregated together. Thus, the initial evidence has greater weighting compared to later evidence. This can be can be written in algebraic terms as

$$S_k = S(x_1) + w_k[s(x_2 + x_3, + \ldots\ldots x_k / x_n) - R]$$

Mathematical calculations can be made to demonstrate how such primacy effects would emerge in the EoS condition, by assigning numerical values to the pieces of evidence, and numerical values to the weighting of evidence. These calculations can be seen in Equations 2-3 (Appendix 8). Further to this theorising, Anderson and Hubert (1963) suggested that people pay less attention to later evidence, thus explaining why later evidence has reduced weighting on the overall judgment. Anderson and Jacobsen (1965) propose that people discount later information as it fails to confirm the early impression they have developed. Future research might examine the precise reasons that explain why primacy emerges.

It was hypothesised in Study 2 that participants with high motivation to think would show no order effects in the EoS condition. In line with Hogarth and Einhorn's (1992) model, it was expected that those with high motivation to think would more effortfully process information in a SbS manner. Similarly, participants with less experience were expected to use SbS strategies to deal with the demands of processing information (Study 2), and participants reporting higher accountability were also expected to use more effortful processing (Study 3). However, in each of these conditions, primacy effects were displayed in the EoS condition. A possible explanation is that some SbS processing was used but the processing of later information involved a very weak weighting compared to the weighting of the anchor. Thus, primacy effects would emerge (see equations 9-10, Appendix 8).

In Study 4, the results showed recency effects in the interpolated condition, whereas in the delay condition, order effects were offset. Indeed, this 60-second delay was the only experimental condition that resulted in primacy effects being offset when EoS judgments were asked for. Luchins (1957) suggested the interpolated tasks created a break between the blocks of information, consequently making it less likely information was perceived as a homogeneous unit. The results indicate a standard EoS response was not made, as the interpolated and delay manipulations meant the evidence following the anchor wasn't aggregated due to the break between blocks of evidence. With such a break between the two blocks of evidence, Hogarth and Einhorn's (1992) algebraic equation can be adjusted to explain how the overall judgment ($S_k$) was arrived at in light of processing the eight pieces of evidence as two blocks of information;

$$S_k = w_k[s(x_1 + x_2 + x_3 + x_4)/4 - R] + w_k[s(x_5 + x_6 + x_7 + x_8)/4 - R]\}$$

The differing order effects that occurred in the interpolated and delay conditions may be explained by different weightings of the two sections of information resulting from each experimental condition. It can be proposed that the time delay condition allowed participants the opportunity to more fully process early information. Consequently, there would be equal weighting of the first block and the second block, and this would explain why no order effects occurred (See equations 14-15 in appendix 8). However, in the interpolated condition, it is unlikely that the first four pieces of information would be processed fully, as the interpolated task would take up cognitive resources. It is therefore likely the early block of evidence had less weighting compared to the later block in the interpolated condition, which explains why recency emerged (See equations 16-17 in appendix 8 for the mathematical calculations that show how these order effects would occur).

*Step-by-step (SbS) judgments*

While the findings of the present thesis support Hogarth and Einhorn's (1992) predictions in the EoS condition, several other findings failed to support the hypotheses drawn from the model. For example, the belief-adjustment model predicts recency in the SbS condition. However, in Study 1 of the present thesis, primacy effects were found for an incomplete SbS processing strategy, and no order effects were found when an extended SbS strategy was used. In the incomplete SbS condition replicating the SbS processing used in Greenlees et al.'s (2007) study, primacy effects were also displayed in the present thesis. Hogarth and Einhorn (1992) explain how SbS processing results in later information having greater weighting compared to the anchor. This can be represented by the equation $S_k = S_{k-1} + w_k[s(x_k) - R]$, where $w_k$ represents the adjustment weight of a piece (the *k*th piece) of evidence. With this weakened method of SbS processing, the adjustment weight ($w_k$) is reduced, meaning later evidence had less weighting on the overall judgment, in comparison with the weighting of initial evidence. Thus, it is apparent the strength of the weighting of later evidence was not enough to offset the influence of the initial anchor. Consequently this weaker SbS processing strategy failed to eliminate primacy effects (this primacy effect can be numerically shown in equations 7-8 in Appendix 8).

In the extended SbS condition though, no order effects were displayed. This more thorough SbS strategy led to an increased weighting of later evidence in comparison to the incomplete SbS processing used in Greenlees et al.'s (2007) study. Thus, if the initial anchor was sufficiently strong, then the extended SbS manipulation may only produce a weighting of later evidence that has the strength to offset primacy effects and leave no order effects (rather than reversing primacy effects to recency effects as suggested by Hogarth and Einhorn). Such a proposal (with crude values assigned) can be demonstrated by the mathematical calculations in Equations 9-10 (Appendix 8). These reduced weightings of later evidence compared to the anchor provided a tentative explanation for the absence of primacy effects in the SbS condition, and further research is needed before such proposals can be substantiated.

The primacy effects displayed in Study 1 were offset when an extended SbS processing strategy was required. The data suggests the SbS processing increased the relative weighting of later evidence compared to the initial anchor, which resulted in primacy effects being offset. This finding provided partial support for Hogarth and Einhorn's (1992) model, which predicts SbS processing eliminates primacy effects and produces recency effects. In this case, it appears that order effects can be offset when more systematic SbS processing is used. A strength of Study 1 was the delay in making these SbS judgments was controlled for, and more data was collected. The primacy effects found in this delay condition indicated that it was the more thorough SbS processing eliminated primacy effects, and not any time delay caused by the SbS processing condition.

In Study 2, less experienced participants showed recency effects when they made SbS judgments. This offered support to Hogarth and Einhorn's predictions of recency in the SbS condition. However, order effects were offset for more experienced participants. This could be due to the different weighting of later information compared to the anchor. For less experienced participants, it is apparent they simply gave an equal weighting to each piece of evidence following the anchor, which explains why recency emerges (e.g. see equations 5-6, Appendix 8). For more experienced participants, if the weighting of later evidence is reduced compared to the anchor (e.g. because they were more committed to their early impression, they discounted or paid less attention to later evidence) then this would explain why order effects are offset in the SbS condition (e.g. see equations 9-10, Appendix 8).

In summary, primacy effects have been found to be a consistent finding when EoS judgments were required. Social cognition theory suggests than people use shortcuts to deal with the demands of processing large amounts of information (Baron & Byrne, 2002). This produces automatic thinking which can result in mental structures such as schemas and stereotypes occurring, which can save mental effort and preserve cognitive capacity (Jonas et al., 2001), but can also result in errors when making judgments. In the present programme of research, it is likely that people use mental shortcuts in the

EoS condition, and the results have provided evidence of an order effect (primacy) bias. Furthermore, in line with schema theory (Fiske & Taylor, 1991), it is possible that the initial evidence produces a schema of a good or bad player, which produces a strong early anchor that leads to primacy effects. In the social psychology literature, order effects have been shown to bias judgments in a variety of other domains (Hogarth & Einhorn, 1992), and findings in the present thesis suggest that order effects also bias judgments of sporting ability. In addition, order effects were eliminated in the thorough SbS condition in Study 1. Furthermore, the 60 second delay in Study 4 eliminated primacy effects in the EoS condition. Thus, the present thesis has provided evidence that SbS processing and delays may reduce or eliminate order effects in assessments of sporting ability.

*Hogarth and Einhorn's (1992) model*

Overall, the results of the present thesis offered some support for the predictions of Hogarth and Einhorn's (1992) model. The consistent findings of primacy in Studies 1-3 in the End-of-sequence condition support the predictions of primacy Hogarth and Einhorn's model when this processing strategy is used. However, while Hogarth and Einhorn's model offers a theoretical explanation for why primacy effects occur (page 30), it is still unclear what cognitions occur to explain precisely why initial evidence has so much influence, and later evidence has much less impact (e.g., through lack of attention to, or discounting of later information). In addition, results in Study 1 in the extended SbS condition revealed no order effects, yet Hogarth and Einhorn's model predicts recency in this condition. Theoretically, it is likely that the additional processing created by the SbS strategy was able to offset primacy, but was not strong enough to produce recency effects. Hogarth and Einhorn's model only offers a partial explanation for why this might occur.

There is also a question of sequence length (Greenlees et al., 2007), and thus, whether the sequence of information used in the present study is considered a long or short series. Hogarth and Einhorn suggest that a long series of information will result in primacy effects, but in their model, they use an arbitrary split of the research to categorise long and short series. In the present study, each piece of evidence could be broken down into smaller components, thus the series of information could theoretically be much longer than just the 8 actual pieces of evidence. Future research should examine this element of Hogarth and Einhorn's model to more effectively categorise long and short series of information. Hogarth and Einhorn's model also predicts that complex information will offset primacy effects, due to an increase in information processing. However, in Study 2 (greater motivation-to-think) and Study 3 (increased accountability), an apparent increase in information processing failed to offset primacy. In light of these findings, Hogarth and Einhorn's model might be revised to explain why primacy effects still occur, even in light of increased processing.

Hogarth and Einhorn (1992) also distinguish between evaluation and estimation tasks. Evaluation tasks involve encoding whether evidence is true or false relative to the hypothesis. In contrast, estimation tasks involve assessing some form of "moving average". In the present thesis, an estimation task was used, with participants asked to assess levels of ability on a 10-point scale, from 'poor' ( = 1) to 'excellent' ( = 10). Future research might examine evaluation tasks. For example, participants could be asked if the target player has the ability to be selected for a certain squad.

## APPLIED IMPLICATIONS FOR ASSESSING SPORTING ABILITY

In an applied setting, Cushing and Ahlawat (1996) suggested people with greater experience, and who are motivated to exert cognitive effort would not allow their judgments to be affected by the order in which evidence was evaluated. Thus, Cushing and Ahlawat questioned whether order effects found in experimental research would still emerge in applied settings. However, primacy was a constant finding in the present thesis. Indeed, participants with higher motivation to think (Study 2) and higher levels of accountability (Study 3) showed primacy effects in the EoS condition. In addition, participants showed primacy effects regardless of level of experience in the EoS condition (Study 2). Thus, the results strongly suggest that primacy is a robust phenomenon when making EoS assessments. Consequently, there are implications for those (e.g. coaches or scouts) who make assessments of sporting ability, as they operate in an environment where they are accountable for their judgments and thus are likely to exert full cognitive effort to make accurate judgments. The consistent finding of primacy effects in the present thesis strongly indicates that primacy is an applied concern for those who make assessments of sporting ability. Furthermore, those who make assessments of ability should be made aware of the way early information might overly bias their overall judgments.

The findings of primacy have further applied implications for athletes themselves. In other experimental settings, for example, studies examining criminal proceedings (e.g. Kerstholt & Jackson, 1998; Costabile & Klein, 2005) have shown recency effects prevalent. Such findings indicate lawyers should present their strongest arguments last to have greatest influence on jurors' judgments. Similarly, the findings from the present thesis can be used to guide players as to how best they might create a favourable impression of their ability. More specifically, as the findings have provided evidence of a primacy effect, then players should be advised to make a strong start, and perform well initially to most positively impact on the judgments of observers.

The potential for early information to bias perceptions of ability might also impact on the coach-athlete relationship. For example, if a player performs well initially, but their performance level subsequently drops, a coach might judge the player's ability higher than it actually is. In this instance, a coach might push an athlete harder or promote them to play at a higher level than they are capable of. However, such a declining performance level might mean the player is lacking confidence at that time. Thus, coach-athlete disagreements might result in light of conflicting perceptions and expectations. Alternatively, an improving athlete might not be rated as highly as they should be, and consequently might be removed from a team or squad just at the time when they were improving. In addition, in this situation, the player may not get the recognition his/her ability deserves. Jones et al. (1968) found evidence of primacy effects when participants observed targets solving intelligence questions, but found recency for participants when assessing their own performance. This indicates further potential problems for the coach-athlete relationships, if the coach was to attribute changes in performance very differently from the athlete themselves. This theorising suggests primacy effects might negatively impact on coach-athlete relationships.

The results of the present thesis suggest a more thorough SbS processing strategy offsets primacy effects. Consequently, these findings could inform the development of practical coaching guidelines. More specifically, individuals who frequently make assessments of ability should be guided to make detailed evaluations of performance regularly in order to offset primacy effects, thus replicating the extended SbS condition. For example, coaches might devise an assessment template, to allow judgments to be updated after new evidence is viewed. Furthermore, in light of the findings in Study 6, short delays might be integrated into the assessment process, to allow for more thorough processing of the evidence. However, it is apparent that such a method of information processing might be difficult to implement in applied settings. For example, the use of SbS methods could be long-winded and time consuming, and thus may be an impractical strategy for selectors to use when observing a large group of athletes at a trial.

## LIMITATIONS AND RECOMMENDATIONS FOR FUTURE RESEARCH

The present study makes a unique contribution to the order effects literature by providing a more thorough examination of the incidence of order effects in sporting judgments. Strengths of the programme of studies include the relatively large sample sizes, the thorough examination of step-by-step strategies, and the additional data collected (in Studies 1 and 4) to control for time delays created in experimental procedures.

The present thesis used the same video footage throughout the programme of studies, with the order of footage arranged so that the target player's performance was seen to start well and then decline, or this same order but reversed. This created a controlled experimental task which allowed us to test certain hypotheses and examine order effects in sporting assessments of ability. However, while this research design has been similarly used in previous order effects' research, there are limitations to this approach. For example, it is questionable how closely this footage actually reflects the type of evidence that a coach would view when making assessments of ability in real settings. It is unlikely that they would see the performance improve or decline in such a linear way. In addition, they might see a certain player perform, and then view performances from other individuals before seeing that player perform again. And finally, a selector might make judgments of a players' ability from viewing performances over a series of time, but the footage in the present thesis only uses a chunk of information from one session, and not over a longer period of time.

In light of these limitations, future research should seek to utilise research designs that most closely match the actual demands placed on an observer making sporting judgments. Indeed, Cushing and Ahlawat (1996) questioned whether order effects found in experimental research would still emerge in applied settings. Thus, future research should use more ecologically valid methodologies to examine order effects in sporting situations. For example, footage of a target player in match situations could be shown to participants, with the footage manipulated to show either a declining or improving performance. In addition, a talent scout or coach viewing a group of players in a training match will have to assess the ability of a number of players. Further research could address this issue by creating situations which order effects might be observed in more complex situations. One suggestion might be for participants to rate footage of two or more players mixed together (with the clips for one target player manipulated in a declining and ascending order). Such a task would more closely match the demands placed on individuals who assess and evaluate a number of players in sporting situations. In addition, to match the demands of selectors who observe a player over a number of sessions, future longitudinal research might be used to examine whether order effects would bias judgments over a longer time frame (e.g., several performances/a whole season).

In addition, procedures used in the present thesis might not fully replicate the demands places on observers making judgments in sport. For example, a talent scout or coach viewing a group of players in a training match will have to assess the ability of a number of players. Further research could address this issue by creating situations which order effects might be observed in more complex situations. One suggestion might be for participants to rate footage of two or more players mixed together (with the clips for one target player manipulated in a declining and ascending order). Such a task would more closely match the demands placed on individuals who assess and evaluate a number of players in sporting situations.

Future research should examine the strategies participants use to process information in the different judgment conditions, in order to determine more precisely why order effects occur. One avenue worthy of future research is to consider why primacy has emerged as a consistent finding in the EoS condition. One explanation is later information might have less influence on the overall judgment due to a reduction of attention paid to later evidence (Anderson & Hubert, 1963). Past research has used eye-tracking systems (e.g. Savelsbergh et al., 2002; Williams & Davids, 1998) to investigate visual search behaviour. Such software could be used to examine whether participants pay less visual attention to later evidence. Thus, such procedures would establish if visual attention decreased through the series of evidence, which would indicate attention decrement is a reason for primacy. Such information would more accurately inform an intervention (such as increased concentration/attention) aimed at increasing attention to relevant later stimuli.

Hogarth and Einhorn (1992) suggested that even when an EoS strategy is required, SbS processing could be used to process information. Hogarth and Einhorn propose that those motivated to think and effortfully process information will use SbS strategies to more fully process information even when an EoS response was required. Such SbS strategies were predicted to offset the influence of early information. However, some findings in the present study failed to support this theorising. For example, primacy effects were displayed by participants with high motivation to think (Study 2) and high accountability (Study 3) when they were expected to use an SbS processing strategy. Future research might use qualitative methods to investigate reasons for these primacy effects. For example, participants could be interviewed to examine how they arrived at their final ratings, and the processing strategies they used. In addition, such qualitative methods might explain reasons participants give for attributing changes in performance. This might support information discounting (Anderson & Jacobson, 1965) which proposed how once a person commits to an initial judgment, they discount further information (due to reasons such as increasing tiredness or changes in motivation) as it fails to confirm their early impression.

A further recommendation for future research in assessments of order effects in sport is to develop a more thorough and reliable measure of assessment of ability. Participants rated the target players on four factors, ultimate frisbee ability (general), disc control, speed of thought, and athleticism. These factors were adapted from Greenlees et al.'s (2007) study, which examined assessments of footballing ability. High correlations between three of the variables (ultimate frisbee ability-general, disc control, speed-of-thought) created a statistical justification for these three variables to be combined into one dependent variable in the present study. A more reliable measure of assessment of ability is needed, but for the present thesis, the priority was to use a suitable measure of ability ratings to allow a more thorough examination into the incidence of order effects in sporting judgments.

Plessner and Haar (2006) highlighted the importance of impressions of players' ability and performance not being biased by any internal or external factors. In the present thesis, strong evidence of an assessment bias was shown, with primacy a consistent finding when one (EoS) judgment of ability was made. Step-by-step judgments offset primacy effects, but in applied settings, these might be time-consuming to implement. Therefore, more research is needed to examine how order effects might be offset in the EoS condition. The present thesis has also provided a more systematic examination of the predictions of Hogarth and Einhorn's (1992) belief-adjustment model. However, factors from the model remain untested (e.g. evaluation/estimation judgments) and furthermore, the preceding discussion has identified a number of further worthwhile research directions. In light of this, it is hoped that the present thesis will stimulate further research in the area, thus producing a broader examination of order effects in sporting judgments.

# CONCLUSIONS

In summary, this thesis has provided support for the predictions of Hogarth and Einhorn's (1992) belief-adjustment model when assessing sporting ability. Greenlees (2007) and his colleagues were the first to investigate order effects in assessments of sporting ability, and this thesis has extended this research by providing a more systematic examination of order effects in the sporting domain. The findings of this research, considered with earlier research in assessments of general ability (e.g. Jones et al., 1968) and research in assessments of sporting ability (Greenlees et al.) suggest that early information can overly influence overall impressions. More specifically, the research has demonstrated a primacy bias when one assessment of ability is asked for after all evidence has been viewed. Furthermore, the findings have indicated that if judgments are updated in a step-by-step manner, then the primacy bias might be offset.

# Appendix 1

## Summary of hypotheses tested

| Hypothesis no. | Hypothesis | Fully Supported - ✓✓<br>Partially Supported -✓<br>Not Supported – ✗ |
|---|---|---|
| **Study 1** | | |
| 1 | In the EoS response condition, primacy effects are predicted. | ✓✓ |
| 2 | In the SbS (short) response condition, primacy effects are predicted. | ✓✓ |
| 3 | In the SbS (extended) response condition, recency effects are predicted. | ✗ |
| 4 | In the delay condition, primacy effects are predicted. | ✓✓ |
| **Study 2** | | |
| 5 | In both the EoS and SbS response conditions, primacy effects are predicted for entity theorists. | ✓ |
| 6 | In both the EoS and SbS response conditions, recency effects are predicted for incremental theorists. | ✗ |
| 7 | In the EoS response condition, primacy effects are predicted for participants with low motivation to think. | ✗ |
| 8 | In the EoS response condition, no order effects are predicted for participants with high motivation to think. | ✗ |
| 9 | In the SbS response condition, no order effects are predicted for either motivation to think group. | ✓ |
| 10 | In the EoS response condition, primacy effects are predicted for more highly experienced participants. | ✓✓ |
| 11 | In the EoS response condition, no order effects are predicted for less experienced | ✗ |

| | | |
|---|---|---|
| | participants. | |
| 12 | In the SbS response condition, no order effects are predicted for either level of experience. | ✓ |
| **Study 3** | | |
| 13 | In the EoS (control) condition, primacy effects are predicted. | ✓✓ |
| 14 | In the accountability manipulation group, no order effects are predicted. | ✗ |
| **Study 4** | | |
| 15 | In the interpolated condition, no order effects are predicted. | ✗ |

## Appendix 2

## Study 1 Assessment Instruments and SPSS Outputs

# Appendix 2.1

## End-of-Sequence Assessment instrument

University of Chichester

**Thank you for agreeing to take part in this study.**

<u>Introduction and Rationale</u>

In the current study we are interested in how people make judgments about the abilities of the individuals they observe when playing and coaching. In this experiment we will be asking you to observe an ultimate frisbee player perform a series of the same skill, which involves the player cutting towards the disc, making a catch, pivoting, and making a forehand pass to a team-mate on the run. You will then be asked to rate his performance and ability. There is no right or wrong answer, just your own impression that is important.

All information you provide will be treated in the strictest of confidence.

Name: ______________________________

Age: __________

Ethnic Origin: ________________

Ultimate playing experience: __________ (years)

(EOS – PN – A1)

**CONSENT FORM**

I, ....................................................... (PRINT NAME)

hereby give my consent to participate in the following test/activity **[investigating impressions of ability in sport]**

By signing this form I confirm that:

- the purpose of the test/activity has been explained to me;
- I am satisfied that I understand the procedures involved;
- the possible benefits and risks of the test/activity have been explained to me;
- any questions which I have asked about the test/activity have been answered to my satisfaction;
- I understand that, during the course of the test/activity, I have the right to ask further questions about it;
- the information which I have supplied to University of Chichester prior to taking part in the test/activity is true and accurate to the best of my knowledge and belief and I understand that I must notify promptly of any changes to the information;
- I understand that my personal information will not be released to any third parties without my permission;
- I understand that my participation in the test/activity is voluntary and I am therefore at liberty to withdraw my involvement at any stage;
- I understand that, if there is any concern about the appropriateness of my continuing in the test/activity, I may be asked to withdraw my involvement at any stage;
- I understand that once the test/activity has been completed, the information gained as a result of it will be used for the following purposes only: **[To explore the way people make impressions of the sporting ability of others]**.

SIGNATURE OF THE SUBJECT .......................................

DATE ................................................

**Evaluation of Player 1**

On a scale of 1 (poor) to 10 (excellent), please rate the ultimate player for the following four criteria. Please circle the number that you feel best rates the player.

Ultimate Ability (general)

| Poor | | | | | | | | | Excellent |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |

Disc control

| Poor | | | | | | | | | Excellent |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |

Speed of Thought

| Poor | | | | | | | | | Excellent |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |

Athleticism

| Poor | | | | | | | | | Excellent |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |

Attitude

| Poor | | | | | | | | | Excellent |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |

**Evaluation of Player 2**

On a scale of 1 (poor) to 10 (excellent), please rate the ultimate player for the following four criteria. Please circle the number that you feel best rates the player.

Ultimate Ability (general)

| Poor | | | | | | | | | Excellent |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |

Disc control

| Poor | | | | | | | | | Excellent |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |

Speed of Thought

| Poor | | | | | | | | | Excellent |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |

Athleticism

| Poor | | | | | | | | | Excellent |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |

Attitude

| Poor | | | | | | | | | Excellent |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |

## Appendix 2.2

## Step-by-Step (short) Assessment Instrument (Player 1 only)

University of Chichester

**Thank you for agreeing to take part in this study.**

Introduction and Rationale

In the current study we are interested in how people make judgments about the abilities of the individuals they observe when playing and coaching. In this experiment we will be asking you to observe an ultimate frisbee player perform a series of the same skill, which involves the player cutting towards the disc, making a catch, pivoting, and making a forehand pass to a team-mate on the run. You will then be asked to rate his performance and ability. There is no right or wrong answer, just your own impression that is important.

All information you provide will be treated in the strictest of confidence.

Name: ______________________________

Age: __________

Ethnic Origin: ______________________

Ultimate playing experience: __________ (years)

(SBS – PN – A1)

University of Chichester

**CONSENT FORM**

I, ........................................................ (PRINT NAME)

hereby give my consent to participate in the following test/activity **[investigating impressions of ability in sport]**

By signing this form I confirm that:

- the purpose of the test/activity has been explained to me;
- I am satisfied that I understand the procedures involved;
- the possible benefits and risks of the test/activity have been explained to me;
- any questions which I have asked about the test/activity have been answered to my satisfaction;
- I understand that, during the course of the test/activity, I have the right to ask further questions about it;
- the information which I have supplied to University of Chichester prior to taking part in the test/activity is true and accurate to the best of my knowledge and belief and I understand that I must notify promptly of any changes to the information;
- I understand that my personal information will not be released to any third parties without my permission;
- I understand that my participation in the test/activity is voluntary and I am therefore at liberty to withdraw my involvement at any stage;
- I understand that, if there is any concern about the appropriateness of my continuing in the test/activity, I may be asked to withdraw my involvement at any stage;
- I understand that once the test/activity has been completed, the information gained as a result of it will be used for the following purposes only: **[To explore the way people make impressions of the sporting ability of others].**

SIGNATURE OF THE SUBJECT .......................................

DATE ................................................

**Overall rating of Player 1 – After Clip 1**

On a scale of 1 (poor) to 10 (excellent), please rate the ultimate player for his overall level of ability. Please circle the number that you feel best rates the player.

Ability Level

| Poor | | | | | | | | | Excellent |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |

**Overall rating of Player 1 – After Clip 2**

On a scale of 1 (poor) to 10 (excellent), please rate the ultimate player for his overall level of ability. Please circle the number that you feel best rates the player.

Ability Level

| Poor | | | | | | | | | Excellent |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |

**Overall rating of Player 1 – After Clip 3**

On a scale of 1 (poor) to 10 (excellent), please rate the ultimate player for his overall level of ability. Please circle the number that you feel best rates the player.

Ability Level

| Poor | | | | | | | | | Excellent |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |

**Overall rating of Player 1 – After Clip 4**

On a scale of 1 (poor) to 10 (excellent), please rate the ultimate player for his overall level of ability. Please circle the number that you feel best rates the player.

Ability Level

| Poor | | | | | | | | | Excellent |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |

**Overall rating of Player 1 – After Clip 5**

On a scale of 1 (poor) to 10 (excellent), please rate the ultimate player for his overall level of ability. Please circle the number that you feel best rates the player.

Ability Level

| Poor | | | | | | | | | Excellent |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |

**Overall rating of Player 1 – After Clip 6**

On a scale of 1 (poor) to 10 (excellent), please rate the ultimate player for his overall level of ability. Please circle the number that you feel best rates the player.

Ability Level

| Poor | | | | | | | | | Excellent |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |

**Overall rating of Player 1 – After Clip 7**

On a scale of 1 (poor) to 10 (excellent), please rate the ultimate player for his overall level of ability. Please circle the number that you feel best rates the player.

Ability Level

| Poor | | | | | | | | | Excellent |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |

**<u>Overall rating of player 1 – after all Clips</u>**

On a scale of 1 (poor) to 10 (excellent), please rate the ultimate player for the following four criteria. Please circle the number that you feel best rates the player.

Ultimate Ability (general)

| Poor | | | | | | | | | Excellent |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |

Disc control

| Poor | | | | | | | | | Excellent |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |

Speed of Thought

| Poor | | | | | | | | | Excellent |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |

Athleticism

| Poor | | | | | | | | | Excellent |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |

Attitude

| Poor | | | | | | | | | Excellent |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |

## Appendix 2.3

## Step-by-Step (extended) Assessment Instrument (Player 1 only)

University of Chichester

**Thank you for agreeing to take part in this study.**

Introduction and Rationale

In the current study we are interested in how people make judgments about the abilities of the individuals they observe when playing and coaching. In this experiment we will be asking you to observe an ultimate frisbee player perform a series of the same skill, which involves the player cutting towards the disc, making a catch, pivoting, and making a forehand pass to a team-mate on the run. You will then be asked to rate his performance and ability. There is no right or wrong answer, just your own impression that is important.

All information you provide will be treated in the strictest of confidence.

Name: ____________________

Age: ____________

Ethnic Origin: ____________________

Ultimate playing experience: __________ (years)

(SBS – PN – A1)

**CONSENT FORM**

I, ...................................................... (PRINT NAME)

hereby give my consent to participate in the following test/activity **[investigating impressions of ability in sport]**

By signing this form I confirm that:

- the purpose of the test/activity has been explained to me;
- I am satisfied that I understand the procedures involved;
- the possible benefits and risks of the test/activity have been explained to me;
- any questions which I have asked about the test/activity have been answered to my satisfaction;
- I understand that, during the course of the test/activity, I have the right to ask further questions about it;
- the information which I have supplied to University of Chichester prior to taking part in the test/activity is true and accurate to the best of my knowledge and belief and I understand that I must notify promptly of any changes to the information;
- I understand that my personal information will not be released to any third parties without my permission;
- I understand that my participation in the test/activity is voluntary and I am therefore at liberty to withdraw my involvement at any stage;
- I understand that, if there is any concern about the appropriateness of my continuing in the test/activity, I may be asked to withdraw my involvement at any stage;
- I understand that once the test/activity has been completed, the information gained as a result of it will be used for the following purposes only: **[To explore the way people make impressions of the sporting ability of others].**

SIGNATURE OF THE SUBJECT ......................................

DATE ...............................................

**Overall rating of Player 1 (After Clip 1)**

On a scale of 1 (poor) to 10 (excellent), please rate the ultimate player for the following four criteria. Please circle the number that you feel best rates the player.

Ultimate Ability (general)

| Poor | | | | | | | | | Excellent |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |

Disc control

| Poor | | | | | | | | | Excellent |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |

Speed of Thought

| Poor | | | | | | | | | Excellent |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |

Athleticism

| Poor | | | | | | | | | Excellent |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |

Attitude

| Poor | | | | | | | | | Excellent |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |

**Overall Rating of Player 1 – (after Clip 2)**

On a scale of 1 (poor) to 10 (excellent), please rate the ultimate player for the following four criteria. Please circle the number that you feel best rates the player.

Ultimate Ability (general)

| Poor | | | | | | | | | Excellent |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |

Disc control

| Poor | | | | | | | | | Excellent |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |

Speed of Thought

| Poor | | | | | | | | | Excellent |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |

Athleticism

| Poor | | | | | | | | | Excellent |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |

Attitude

| Poor | | | | | | | | | Excellent |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |

**Overall Rating of Player 1 (After Clip 3)**

On a scale of 1 (poor) to 10 (excellent), please rate the ultimate player for the following four criteria. Please circle the number that you feel best rates the player.

Ultimate Ability (general)

| Poor | | | | | | | | | Excellent |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |

Disc control

| Poor | | | | | | | | | Excellent |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |

Speed of Thought

| Poor | | | | | | | | | Excellent |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |

Athleticism

| Poor | | | | | | | | | Excellent |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |

Attitude

| Poor | | | | | | | | | Excellent |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |

**Overall Rating of Player 1 (After Clip 4)**

On a scale of 1 (poor) to 10 (excellent), please rate the ultimate player for the following four criteria. Please circle the number that you feel best rates the player.

Ultimate Ability (general)

| Poor | | | | | | | | | Excellent |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |

Disc control

| Poor | | | | | | | | | Excellent |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |

Speed of Thought

| Poor | | | | | | | | | Excellent |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |

Athleticism

| Poor | | | | | | | | | Excellent |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |

Attitude

| Poor | | | | | | | | | Excellent |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |

**Overall rating of Player 1 (After Clip 5)**

On a scale of 1 (poor) to 10 (excellent), please rate the ultimate player for the following five criteria. Please circle the number that you feel best rates the player.

Ultimate Ability (general)

| Poor | | | | | | | | | Excellent |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |

Disc control

| Poor | | | | | | | | | Excellent |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |

Speed of Thought

| Poor | | | | | | | | | Excellent |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |

Athleticism

| Poor | | | | | | | | | Excellent |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |

Attitude

| Poor | | | | | | | | | Excellent |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |

**Overall Rating of Player 1 (After Clip 6)**

On a scale of 1 (poor) to 10 (excellent), please rate the ultimate player for the following four criteria. Please circle the number that you feel best rates the player.

Ultimate Ability (general)

Poor Excellent

1 2 3 4 5 6 7 8 9 10

Disc control

Poor Excellent

1 2 3 4 5 6 7 8 9 10

Speed of Thought

Poor Excellent

1 2 3 4 5 6 7 8 9 10

Athleticism

Poor Excellent

1 2 3 4 5 6 7 8 9 10

Attitude

Poor Excellent

1 2 3 4 5 6 7 8 9 10

**Overall rating of Player 1 (After Clip 7)**

On a scale of 1 (poor) to 10 (excellent), please rate the ultimate player for the following four criteria. Please circle the number that you feel best rates the player.

Ultimate Ability (general)

| Poor | | | | | | | | | Excellent |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |

Disc control

| Poor | | | | | | | | | Excellent |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |

Speed of Thought

| Poor | | | | | | | | | Excellent |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |

Athleticism

| Poor | | | | | | | | | Excellent |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |

Attitude

| Poor | | | | | | | | | Excellent |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |

**Overall rating of player 1 (after Clip 8)**

On a scale of 1 (poor) to 10 (excellent), please rate the ultimate player for the following four criteria. Please circle the number that you feel best rates the player.

Ultimate Ability (general)

| Poor | | | | | | | | | Excellent |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |

Disc control

| Poor | | | | | | | | | Excellent |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |

Speed of Thought

| Poor | | | | | | | | | Excellent |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |

Athleticism

| Poor | | | | | | | | | Excellent |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |

Attitude

| Poor | | | | | | | | | Excellent |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |

## Appendix 2.4

## SPSS Outputs for Study 1

# Ordering the Clips

**Within-Subjects Factors**

Measure: MEASURE_1

| rating | Dependent Variable |
|---|---|
| 1 | clip14 |
| 2 | clip11 |
| 3 | clip9 |
| 4 | clip20 |
| 5 | clip7 |
| 6 | clip1 |
| 7 | clip22 |
| 8 | clip8 |
| 9 | clip19 |

**Descriptive Statistics**

| | Mean | Std. Deviation | N |
|---|---|---|---|
| clip14 | 7.5000 | 1.06904 | 8 |
| clip11 | 7.2500 | 1.28174 | 8 |
| clip9 | 6.7500 | 1.38873 | 8 |
| clip20 | 5.3750 | 1.40789 | 8 |
| clip7 | 4.7500 | .70711 | 8 |
| clip1 | 4.3750 | .51755 | 8 |
| clip22 | 3.2500 | .46291 | 8 |
| clip8 | 3.1250 | .64087 | 8 |
| clip19 | 1.2500 | .46291 | 8 |

**Mauchly's Test of Sphericity(b)**

Measure: MEASURE_1

| Within Subjects Effect | Mauchly's W | Approx. Chi-Square | Df | Sig. | Epsilon(a) | | |
|---|---|---|---|---|---|---|---|
| | Greenhouse-Geisser | Huynh-Feldt | Lower-bound | Greenhouse-Geisser | Huynh-Feldt | Lower-bound | Greenhouse-Geisser |
| rating | .000 | . | 35 | . | .400 | .775 | .125 |

Tests the null hypothesis that the error covariance matrix of the orthonormalized transformed dependent variables is proportional to an identity matrix.

a May be used to adjust the degrees of freedom for the averaged tests of significance. Corrected tests are displayed in the Tests of Within-Subjects Effects table.

b Design: Intercept Within Subjects Design: rating

**Tests of Between-Subjects Effects**

Measure: MEASURE_1

Transformed Variable: Average

| Source | Type III Sum of Squares | Df | Mean Square | F | Sig. |
|---|---|---|---|---|---|
| Intercept | 1691.681 | 1 | 1691.681 | 612.945 | .000 |
| Error | 19.319 | 7 | 2.760 | | |

**Estimates**

Measure: MEASURE_1

| rating | Mean | Std. Error | 95% Confidence Interval | |
|---|---|---|---|---|
| | Lower Bound | Upper Bound | Lower Bound | Upper Bound |
| 1 | 7.500 | .378 | 6.606 | 8.394 |
| 2 | 7.250 | .453 | 6.178 | 8.322 |
| 3 | 6.750 | .491 | 5.589 | 7.911 |
| 4 | 5.375 | .498 | 4.198 | 6.552 |
| 5 | 4.750 | .250 | 4.159 | 5.341 |
| 6 | 4.375 | .183 | 3.942 | 4.808 |
| 7 | 3.250 | .164 | 2.863 | 3.637 |
| 8 | 3.125 | .227 | 2.589 | 3.661 |
| 9 | 1.250 | .164 | .863 | 1.637 |

**Pairwise Comparisons**

Measure: MEASURE_1

| (I) rating | (J) rating | Mean Difference (I-J) | Std. Error | Sig.(a) | 95% Confidence Interval for Difference(a) | |
|---|---|---|---|---|---|---|
| | | Lower Bound | Upper Bound | Lower Bound | Upper Bound | Lower Bound |
| 1 | 2 | .250 | .313 | 1.000 | -1.350 | 1.850 |
| | 3 | .750 | .453 | 1.000 | -1.564 | 3.064 |
| | 4 | 2.125 | .479 | .109 | -.324 | 4.574 |
| | 5 | 2.750(*) | .412 | .010 | .647 | 4.853 |
| | 6 | 3.125(*) | .515 | .018 | .493 | 5.757 |
| | 7 | 4.250(*) | .366 | .000 | 2.381 | 6.119 |
| | 8 | 4.375(*) | .324 | .000 | 2.721 | 6.029 |
| | 9 | 6.250(*) | .313 | .000 | 4.650 | 7.850 |
| 2 | 1 | -.250 | .313 | 1.000 | -1.850 | 1.350 |
| | 3 | .500 | .463 | 1.000 | -1.864 | 2.864 |
| | 4 | 1.875 | .549 | .403 | -.928 | 4.678 |
| | 5 | 2.500(*) | .463 | .036 | .136 | 4.864 |
| | 6 | 2.875(*) | .549 | .043 | .072 | 5.678 |
| | 7 | 4.000(*) | .500 | .003 | 1.447 | 6.553 |
| | 8 | 4.125(*) | .350 | .000 | 2.336 | 5.914 |
| | 9 | 6.000(*) | .378 | .000 | 4.070 | 7.930 |
| 3 | 1 | -.750 | .453 | 1.000 | -3.064 | 1.564 |
| | 2 | -.500 | .463 | 1.000 | -2.864 | 1.864 |
| | 4 | 1.375(*) | .263 | .044 | .032 | 2.718 |
| | 5 | 2.000 | .500 | .187 | -.553 | 4.553 |
| | 6 | 2.375 | .498 | .073 | -.167 | 4.917 |
| | 7 | 3.500(*) | .567 | .016 | .605 | 6.395 |
| | 8 | 3.625(*) | .532 | .009 | .906 | 6.344 |
| | 9 | 5.500(*) | .378 | .000 | 3.570 | 7.430 |
| 4 | 1 | -2.125 | .479 | .109 | -4.574 | .324 |
| | 2 | -1.875 | .549 | .403 | -4.678 | .928 |
| | 3 | -1.375(*) | .263 | .044 | -2.718 | -.032 |
| | 5 | .625 | .532 | 1.000 | -2.094 | 3.344 |
| | 6 | 1.000 | .535 | 1.000 | -1.730 | 3.730 |
| | 7 | 2.125 | .515 | .160 | -.507 | 4.757 |
| | 8 | 2.250 | .526 | .132 | -.437 | 4.937 |
| | 9 | 4.125(*) | .441 | .001 | 1.875 | 6.375 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 5 | 1 | -2.750(*) | .412 | .010 | -4.853 | -.647 |
| | 2 | -2.500(*) | .463 | .036 | -4.864 | -.136 |
| | 3 | -2.000 | .500 | .187 | -4.553 | .553 |
| | 4 | -.625 | .532 | 1.000 | -3.344 | 2.094 |
| | 6 | .375 | .263 | 1.000 | -.968 | 1.718 |
| | 7 | 1.500(*) | .267 | .029 | .135 | 2.865 |
| | 8 | 1.625(*) | .263 | .016 | .282 | 2.968 |
| | 9 | 3.500(*) | .267 | .000 | 2.135 | 4.865 |
| 6 | 1 | -3.125(*) | .515 | .018 | -5.757 | -.493 |
| | 2 | -2.875(*) | .549 | .043 | -5.678 | -.072 |
| | 3 | -2.375 | .498 | .073 | -4.917 | .167 |
| | 4 | -1.000 | .535 | 1.000 | -3.730 | 1.730 |
| | 5 | -.375 | .263 | 1.000 | -1.718 | .968 |
| | 7 | 1.125 | .295 | .238 | -.382 | 2.632 |
| | 8 | 1.250 | .366 | .403 | -.619 | 3.119 |
| | 9 | 3.125(*) | .227 | .000 | 1.968 | 4.282 |
| 7 | 1 | -4.250(*) | .366 | .000 | -6.119 | -2.381 |
| | 2 | -4.000(*) | .500 | .003 | -6.553 | -1.447 |
| | 3 | -3.500(*) | .567 | .016 | -6.395 | -.605 |
| | 4 | -2.125 | .515 | .160 | -4.757 | .507 |
| | 5 | -1.500(*) | .267 | .029 | -2.865 | -.135 |
| | 6 | -1.125 | .295 | .238 | -2.632 | .382 |
| | 8 | .125 | .227 | 1.000 | -1.032 | 1.282 |
| | 9 | 2.000(*) | .267 | .005 | .635 | 3.365 |
| 8 | 1 | -4.375(*) | .324 | .000 | -6.029 | -2.721 |
| | 2 | -4.125(*) | .350 | .000 | -5.914 | -2.336 |
| | 3 | -3.625(*) | .532 | .009 | -6.344 | -.906 |
| | 4 | -2.250 | .526 | .132 | -4.937 | .437 |
| | 5 | -1.625(*) | .263 | .016 | -2.968 | -.282 |
| | 6 | -1.250 | .366 | .403 | -3.119 | .619 |
| | 7 | -.125 | .227 | 1.000 | -1.282 | 1.032 |
| | 9 | 1.875(*) | .295 | .014 | .368 | 3.382 |
| 9 | 1 | -6.250(*) | .313 | .000 | -7.850 | -4.650 |
| | 2 | -6.000(*) | .378 | .000 | -7.930 | -4.070 |
| | 3 | -5.500(*) | .378 | .000 | -7.430 | -3.570 |
| | 4 | -4.125(*) | .441 | .001 | -6.375 | -1.875 |
| | 5 | -3.500(*) | .267 | .000 | -4.865 | -2.135 |
| | 6 | -3.125(*) | .227 | .000 | -4.282 | -1.968 |
| | 7 | -2.000(*) | .267 | .005 | -3.365 | -.635 |
| | 8 | -1.875(*) | .295 | .014 | -3.382 | -.368 |

**Based on estimated marginal means**
*** The mean difference is significant at the .05 level.a Adjustment for multiple comparisons: Bonferroni.**

## Descriptive Statistics (Study 1)

**Statistics**

gender

| | | |
|---|---|---|
| N | Valid | 240 |
| | Missing | 0 |

**gender**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | male | 187 | 77.9 | 77.9 | 77.9 |
| | female | 53 | 22.1 | 22.1 | 100.0 |
| | Total | 240 | 100.0 | 100.0 | |

**Descriptive Statistics**

| | N | Minimum | Maximum | Mean | Std. Deviation |
|---|---|---|---|---|---|
| age | 240 | 16.00 | 41.00 | 23.2917 | 4.17884 |
| experience | 240 | .25 | 20.00 | 4.0094 | 3.46269 |
| Valid N (listwise) | 240 | | | | |

## Correlations between subscales (Study 1)

**Correlations**

| | | P1_ultimate_ability | P1_athleticism | P1_disc_control | P1_speed_of thought | P1_attitude |
|---|---|---|---|---|---|---|
| P1_ultimate_ability | Pearson Correlation | 1.000 | .622** | .673** | .595** | .468** |
| | Sig. (2-tailed) | | .000 | .000 | .000 | .000 |
| | N | 240 | 240 | 240 | 240 | 240 |
| P1_athleticism | Pearson Correlation | .622** | 1.000 | .443** | .418** | .513** |
| | Sig. (2-tailed) | .000 | | .000 | .000 | .000 |
| | N | 240 | 240 | 240 | 240 | 240 |
| P1_disc_control | Pearson Correlation | .673** | .443** | 1.000 | .555** | .304** |
| | Sig. (2-tailed) | .000 | .000 | | .000 | .000 |
| | N | 240 | 240 | 240 | 240 | 240 |
| P1_speed_of_thought | Pearson Correlation | .595** | .418** | .555** | 1.000 | .469** |
| | Sig. (2-tailed) | .000 | .000 | .000 | | .000 |
| | N | 240 | 240 | 240 | 240 | 240 |
| P1_attitude | Pearson Correlation | .468** | .513** | .304** | .469** | 1.000 |
| | Sig. (2-tailed) | .000 | .000 | .000 | .000 | |
| | N | 240 | 240 | 240 | 240 | 240 |

**. Correlation is significant at the 0.01 level (2-tailed).

**Correlations**

| | | P2_ultimate_ability | P2_athleticism | P2_disc_control | P2_speed_of_thought | P2_attitude |
|---|---|---|---|---|---|---|
| P2_ultimate_ability | Pearson Correlation | 1.000 | .710** | .777** | .719** | .496** |
| | Sig. (2-tailed) | | .000 | .000 | .000 | .000 |
| | N | 240 | 240 | 240 | 240 | 240 |
| P2_athleticism | Pearson Correlation | .710** | 1.000 | .499** | .579** | .477** |
| | Sig. (2-tailed) | .000 | | .000 | .000 | .000 |
| | N | 240 | 240 | 240 | 240 | 240 |
| P2_disc_control | Pearson Correlation | .777** | .499** | 1.000 | .652** | .430** |
| | Sig. (2-tailed) | .000 | .000 | | .000 | .000 |
| | N | 240 | 240 | 240 | 240 | 240 |
| P2_speed_of_thought | Pearson Correlation | .719** | .579** | .652** | 1.000 | .470** |
| | Sig. (2-tailed) | .000 | .000 | .000 | | .000 |
| | N | 240 | 240 | 240 | 240 | 240 |
| P2_attitude | Pearson Correlation | .496** | .477** | .430** | .470** | 1.000 |
| | Sig. (2-tailed) | .000 | .000 | .000 | .000 | |
| | N | 240 | 240 | 240 | 240 | 240 |

**. Correlation is significant at the 0.01 level (2-tailed).

## ANCOVA assumptions (Study 1)

**Between-Subjects Factors**

| | | Value Label | N |
|---|---|---|---|
| pn_np | 1 | pn | 120 |
| | 2 | np | 120 |
| sbs_eos_delay | 1 | EOS | 60 |
| | 2 | SbS (short) | 60 |
| | 3 | SbS (extended) | 60 |
| | 4 | delay | 60 |

**Descriptive Statistics**

Dependent Variable:P1_UA_DC_SoT

| pn_np | sbs_eos_delay | Mean | Std. Deviation | N |
|---|---|---|---|---|
| pn | EOS | 6.6000 | .86392 | 30 |
| | SbS (short) | 6.2444 | .84728 | 30 |
| | SbS (extended) | 6.3556 | 1.07900 | 30 |
| | delay | 6.7333 | .85948 | 30 |
| | Total | 6.3583 | .98273 | 120 |
| np | EOS | 6.4444 | 1.02211 | 30 |
| | SbS (short) | 6.4222 | .86185 | 30 |
| | SbS (extended) | 6.7222 | 1.22579 | 30 |
| | delay | 6.2889 | .81993 | 30 |
| | Total | 6.4694 | .99532 | 120 |
| Total | EOS | 6.5222 | .94154 | 60 |
| | SbS (short) | 6.0833 | .91364 | 60 |
| | SbS (extended) | 6.5389 | 1.15973 | 60 |
| | delay | 6.5111 | .86241 | 60 |
| | Total | 6.4139 | .98854 | 240 |

**Levene's Test of Equality of Error Variances[a]**

Dependent Variable:P1_UA_DC_SoT

| F | df1 | df2 | Sig. |
|---|---|---|---|
| 1.428 | 7 | 232 | .195 |

Tests the null hypothesis that the error variance of the dependent variable is equal across groups.

a. Design: Intercept + pn_np + sbs_eos_delay + pn_np * sbs_eos_delay

**Tests of Between-Subjects Effects**

Dependent Variable:P1_UA_DC_SoT

| Source | Type III Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|
| Corrected Model | 20.998[a] | 7 | 3.000 | 3.274 | .002 |
| Intercept | 9873.113 | 1 | 9873.113 | 10776.299 | .000 |
| pn_np | .741 | 1 | .741 | .809 | .369 |
| sbs_eos_delay | 8.765 | 3 | 2.922 | 3.189 | .024 |
| pn_np * sbs_eos_delay | 11.493 | 3 | 3.831 | 4.181 | .207 |
| Error | 212.556 | 232 | .916 | | |
| Total | 10106.667 | 240 | | | |
| Corrected Total | 233.554 | 239 | | | |

a. R Squared = .090 (Adjusted R Squared = .062)

**Between-Subjects Factors**

| | | Value Label | N |
|---|---|---|---|
| pn_np | 1 | pn | 120 |
| | 2 | np | 120 |
| sbs_eos_delay | 1 | EOS | 60 |
| | 2 | SbS (short) | 60 |
| | 3 | SbS (extended) | 60 |
| | 4 | delay | 60 |

**Descriptive Statistics**

Dependent Variable:P1_athleticism

| pn_np | sbs_eos_delay | Mean | Std. Deviation | N |
|---|---|---|---|---|
| pn | EOS | 6.4667 | 1.10589 | 30 |
| | SbS (short) | 5.9667 | 1.32570 | 30 |
| | SbS (extended) | 6.2667 | .98027 | 30 |
| | delay | 6.3667 | 1.29943 | 30 |
| | Total | 6.2667 | 1.18629 | 120 |
| np | EOS | 6.4333 | 1.04000 | 30 |
| | SbS (short) | 6.3000 | 1.29055 | 30 |
| | SbS (extended) | 6.7333 | 1.20153 | 30 |
| | delay | 6.2000 | 1.27035 | 30 |
| | Total | 6.4167 | 1.20631 | 120 |
| Total | EOS | 6.4500 | 1.06445 | 60 |
| | SbS (short) | 6.1333 | 1.30795 | 60 |
| | SbS (extended) | 6.5000 | 1.11233 | 60 |
| | delay | 6.2833 | 1.27680 | 60 |
| | Total | 6.3417 | 1.19620 | 240 |

**Levene's Test of Equality of Error Variances[a]**

Dependent Variable:P1_athleticism

| F | df1 | df2 | Sig. |
|---|---|---|---|
| 1.001 | 7 | 232 | .431 |

Tests the null hypothesis that the error variance of the dependent variable is equal across groups.

a. Design: Intercept + pn_np + sbs_eos_delay + pn_np * sbs_eos_delay

**Tests of Between-Subjects Effects**

Dependent Variable:P1_athleticism

| Source | Type III Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|
| Corrected Model | 10.383[a] | 7 | 1.483 | 1.038 | .405 |
| Intercept | 9652.017 | 1 | 9652.017 | 6752.919 | .000 |
| pn_np | 1.350 | 1 | 1.350 | .945 | .332 |
| sbs_eos_delay | 5.017 | 3 | 1.672 | 1.170 | .322 |
| pn_np * sbs_eos_delay | 4.017 | 3 | 1.339 | .937 | .424 |
| Error | 331.600 | 232 | 1.429 | | |
| Total | 9994.000 | 240 | | | |
| Corrected Total | 341.983 | 239 | | | |

a. R Squared = .030 (Adjusted R Squared = .001)

## Order by judgment condition interactions (Study 1)

## COMBINED CONSTRUCT

**Between-Subjects Factors**

| | | Value Label | N |
|---|---|---|---|
| pn_np | 1 | Pn | 120 |
| | 2 | Np | 120 |
| sbs_eos_delay | 1 | EOS | 60 |
| | 2 | SbS (short) | 60 |
| | 3 | SbS (extended) | 60 |
| | 4 | Delay | 60 |

**Descriptive Statistics**

Dependent Variable:P2_UA_DC_SoT

| pn_np | sbs_eos_delay | Mean | Std. Deviation | N |
|---|---|---|---|---|
| pn | EOS | 5.8889 | 1.04068 | 30 |
| | SbS (short) | 5.5000 | 1.30546 | 30 |
| | SbS (extended) | 4.8111 | 1.50779 | 30 |
| | delay | 5.6556 | 1.12609 | 30 |
| | Total | 5.4389 | 1.30572 | 120 |
| np | EOS | 4.9778 | 1.06829 | 30 |
| | SbS (short) | 4.9444 | 1.19091 | 30 |
| | SbS (extended) | 5.1667 | 1.44834 | 30 |
| | delay | 4.6667 | 1.28654 | 30 |
| | Total | 4.9389 | 1.25318 | 120 |
| Total | EOS | 5.4333 | 1.14207 | 60 |
| | SbS (short) | 5.1722 | 1.25998 | 60 |
| | SbS (extended) | 4.9889 | 1.47671 | 60 |
| | delay | 5.1611 | 1.29826 | 60 |
| | Total | 5.1889 | 1.30138 | 240 |

**Levene's Test of Equality of Error Variances[a]**

Dependent Variable:P2_UA_DC_SoT

| F | df1 | df2 | Sig. |
|---|---|---|---|
| 1.321 | 7 | 232 | .241 |

Tests the null hypothesis that the error variance of the dependent variable is equal across groups.

a. Design: Intercept + P1_UA_DC_SoT + pn_np + sbs_eos_delay + pn_np * sbs_eos_delay

**Tests of Between-Subjects Effects**

DependentVariable:P2_UA_DC_SoT

| Source | Type III Sum of Squares | df | Mean Square | F | Sig. | Partial Eta Squared | Noncent. Parameter | Observed Power[b] |
|---|---|---|---|---|---|---|---|---|
| Corrected Model | 75.670[a] | 8 | 9.459 | 6.639 | .000 | .187 | 53.114 | 1.000 |
| Intercept | 31.490 | 1 | 31.490 | 22.103 | .000 | .087 | 22.103 | .997 |
| P1_UA_DC_SoT | 37.492 | 1 | 37.492 | 26.316 | .000 | .102 | 26.316 | .999 |
| pn_np | 17.868 | 1 | 17.868 | 12.542 | .000 | .051 | 12.542 | .941 |
| sbs_eos_delay | 7.325 | 3 | 2.442 | 1.714 | .165 | .022 | 5.142 | .445 |
| pn_np * sbs_eos_delay | 11.189 | 3 | 3.730 | 2.618 | .052 | .033 | 7.854 | .637 |
| Error | 329.100 | 231 | 1.425 | | | | | |
| Total | 6866.667 | 240 | | | | | | |
| Corrected Total | 404.770 | 239 | | | | | | |

a. R Squared = .187 (Adjusted R Squared = .159)

## ATHLETICISM

**Between-Subjects Factors**

| | | Value Label | N |
|---|---|---|---|
| pn_np | 1 | pn | 120 |
| | 2 | np | 120 |
| sbs_eos_delay | 1 | EOS | 60 |
| | 2 | SbS (short) | 60 |
| | 3 | SbS (extended) | 60 |
| | 4 | delay | 60 |

**Descriptive Statistics**

Dependent Variable:P2_athleticism

| pn_np | sbs_eos_delay | Mean | Std. Deviation | N |
|---|---|---|---|---|
| pn | EOS | 4.6333 | 1.35146 | 30 |
| | SbS (short) | 4.7000 | 1.74494 | 30 |
| | SbS (extended) | 4.3667 | 1.44993 | 30 |
| | delay | 5.0333 | 1.32570 | 30 |
| | Total | 4.6833 | 1.47804 | 120 |
| np | EOS | 4.6000 | .96847 | 30 |
| | SbS (short) | 4.7000 | 1.70496 | 30 |
| | SbS (extended) | 4.7667 | 1.47819 | 30 |
| | delay | 4.6667 | 1.37297 | 30 |
| | Total | 4.6833 | 1.39014 | 120 |
| Total | EOS | 4.6167 | 1.16578 | 60 |
| | SbS (short) | 4.7000 | 1.71039 | 60 |
| | SbS (extended) | 4.5667 | 1.46561 | 60 |
| | delay | 4.8500 | 1.35077 | 60 |
| | Total | 4.6833 | 1.43176 | 240 |

**Levene's Test of Equality of Error Variances[a]**

Dependent Variable:P2_athleticism

| F | df1 | df2 | Sig. |
|---|---|---|---|
| 1.086 | 7 | 232 | .373 |

Tests the null hypothesis that the error variance of the dependent variable is equal across groups.

**Levene's Test of Equality of Error Variances[a]**

Dependent Variable:P2_athleticism

| F | df1 | df2 | Sig. |
|---|---|---|---|
| 1.086 | 7 | 232 | .373 |

Tests the null hypothesis that the error variance of the dependent variable is equal across groups.

a. Design: Intercept + P1_athleticism + pn_np + sbs_eos_delay + pn_np * sbs_eos_delay

**Tests of Between-Subjects Effects**

Dependent Variable:P2_athleticism

| Source | Type III Sum of Squares | df | Mean Square | F | Sig. | Partial Eta Squared | Noncent. Parameter | Observed Power[b] |
|---|---|---|---|---|---|---|---|---|
| Corrected Model | 29.280[a] | 8 | 3.660 | 1.835 | .071 | .060 | 14.683 | .772 |
| Intercept | 74.005 | 1 | 74.005 | 37.111 | .000 | .138 | 37.111 | 1.000 |
| P1_athleticism | 22.080 | 1 | 22.080 | 11.072 | .001 | .046 | 11.072 | .912 |
| pn_np | .090 | 1 | .090 | .045 | .832 | .000 | .045 | .055 |
| sbs_eos_delay | 4.266 | 3 | 1.422 | .713 | .545 | .009 | 2.139 | .201 |
| pn_np * sbs_eos_delay | 2.752 | 3 | .917 | .460 | .710 | .006 | 1.380 | .142 |
| Error | 460.654 | 231 | 1.994 | | | | | |
| Total | 5754.000 | 240 | | | | | | |
| Corrected Total | 489.933 | 239 | | | | | | |

a. R Squared = .060 (Adjusted R Squared = .027)

b. Computed using alpha = .05

## ATTITUDE

**Between-Subjects Factors**

| | | Value Label | N |
|---|---|---|---|
| pn_np | 1 | pn | 120 |
| | 2 | np | 120 |
| sbs_eos_delay | 1 | EOS | 60 |
| | 2 | SBS | 60 |
| | 3 | delay | 60 |
| | 4 | sbs(short) | 60 |

**Descriptive Statistics**

Dependent Variable:P2_attitude

| pn_np | sbs_eos_delay | Mean | Std. Deviation | N |
|---|---|---|---|---|
| pn | EOS | 5.8667 | 1.40770 | 30 |
| | SBS | 4.8667 | 1.45586 | 30 |
| | delay | 5.7667 | 1.52414 | 30 |
| | sbs(short) | 5.7333 | 1.48401 | 30 |
| | Total | 5.5583 | 1.50515 | 120 |
| np | EOS | 5.6667 | 1.24106 | 30 |
| | SBS | 5.5333 | 1.73669 | 30 |
| | delay | 5.9667 | 1.62912 | 30 |
| | sbs(short) | 5.8000 | 1.54026 | 30 |
| | Total | 5.7417 | 1.53664 | 120 |
| Total | EOS | 5.7667 | 1.31956 | 60 |
| | SBS | 5.2000 | 1.62397 | 60 |
| | delay | 5.8667 | 1.56732 | 60 |
| | sbs(short) | 5.7667 | 1.49991 | 60 |
| | Total | 5.6500 | 1.52057 | 240 |

**Levene's Test of Equality of Error Variances[a]**

Dependent Variable:P2_attitude

| F | df1 | df2 | Sig. |
|---|---|---|---|
| 1.090 | 7 | 232 | .370 |

Tests the null hypothesis that the error variance of the dependent variable is equal across groups.

a. Design: Intercept + P1_attitude + pn_np + sbs_eos_delay + pn_np * sbs_eos_delay

**Tests of Between-Subjects Effects**

Dependent Variable:P2_attitude

| Source | Type III Sum of Squares | df | Mean Square | F | Sig. | Partial Eta Squared | Noncent. Parameter | Observed Power[b] |
|---|---|---|---|---|---|---|---|---|
| Corrected Model | 106.385[a] | 8 | 13.298 | 6.884 | .000 | .193 | 55.074 | 1.000 |
| Intercept | 51.179 | 1 | 51.179 | 26.495 | .000 | .103 | 26.495 | .999 |
| P1_attitude | 81.852 | 1 | 81.852 | 42.374 | .000 | .155 | 42.374 | 1.000 |
| pn_np | .601 | 1 | .601 | .311 | .577 | .001 | .311 | .086 |
| sbs_eos_delay | 13.613 | 3 | 4.538 | 2.349 | .073 | .030 | 7.048 | .585 |
| pn_np * sbs_eos_delay | 10.368 | 3 | 3.456 | 1.789 | .150 | .023 | 5.367 | .463 |
| Error | 446.215 | 231 | 1.932 | | | | | |
| Total | 8214.000 | 240 | | | | | | |
| Corrected Total | 552.600 | 239 | | | | | | |

a. R Squared = .193 (Adjusted R Squared = .165)

b. Computed using alpha = .05

## Post-hoc tests (Study 1)

## COMBINED CONSTRUCT

**Group Statistics**

| sbs_eos_delay | | pn_np | N | Mean | Std. Deviation | Std. Error Mean |
|---|---|---|---|---|---|---|
| EOS | Player2_adjustedscore | pn | 30 | -.7111 | 1.31229 | .23959 |
| | | np | 30 | -1.4667 | 1.17313 | .21418 |
| SbS (short) | Player2_adjustedscore | pn | 30 | -.3444 | 1.29982 | .23731 |
| | | np | 30 | -1.4778 | 1.14699 | .20941 |
| SbS (extended) | Player2_adjustedscore | pn | 30 | -1.5444 | 1.41281 | .25794 |
| | | np | 30 | -1.5556 | 1.43394 | .26180 |
| delay | Player2_adjustedscore | pn | 30 | -1.0000 | 1.31306 | .23973 |
| | | np | 30 | -1.6889 | 1.33888 | .24444 |

**Independent Samples Test**

| sbs_eos_delay | | | Levene's Test for Equality of Variances F | Sig. | t-test for Equality of Means t | df | Sig. (2-tailed) | Mean Difference | Std. Error Difference | 95% Confidence Interval of the Difference Lower | Upper |
|---|---|---|---|---|---|---|---|---|---|---|---|
| EOS | Player2_ adjusted score | Equal variances assumed | 1.557 | .217 | 2.351 | 58 | .022 | .75556 | .32137 | .11227 | 1.39885 |
| | | Equal variances not assumed | | | 2.351 | 57.28 | .022 | .75556 | .32137 | .11210 | 1.39902 |
| SbS (short) | Player2_ adjusted score | Equal variances assumed | 1.778 | .188 | 3.581 | 58 | .001 | 1.13333 | .31650 | .49980 | 1.76687 |
| | | Equal variances not assumed | | | 3.581 | 57.11 | .001 | 1.13333 | .31650 | .49959 | 1.76708 |
| SbS (extended) | Player2_ adjusted score | Equal variances assumed | .004 | .952 | .030 | 58 | .976 | .01111 | .36752 | -.7245 | .74679 |
| | | Equal variances not assumed | | | .030 | 57.98 | .976 | .01111 | .36752 | -.7245 | .74680 |
| delay | Player2_ adjusted score | Equal variances assumed | .537 | .467 | 2.012 | 58 | .047 | .68889 | .34238 | .00354 | 1.37424 |
| | | Equal variances not assumed | | | 2.012 | 57.97 | .047 | .68889 | .34238 | .00353 | 1.37424 |

## Average Means after each piece of evidence in the SbS (extended condition)

**Descriptive Statistics**

| pn_np | | N | Minimum | Maximum | Mean | Std. Deviation |
|---|---|---|---|---|---|---|
| pn | P2_Q1 | 30 | 3.33 | 8.33 | 5.6222 | 1.27377 |
| | P2_Q2 | 30 | 2.00 | 8.33 | 5.6000 | 1.58634 |
| | P2_Q3 | 30 | 3.00 | 8.00 | 5.8889 | 1.52208 |
| | P2_Q4 | 30 | 2.67 | 8.33 | 6.1111 | 1.64779 |
| | P2_Q5 | 30 | 1.00 | 8.33 | 5.3889 | 1.69082 |
| | P2_Q6 | 30 | 1.00 | 7.33 | 4.8333 | 1.62299 |
| | P2_Q7 | 30 | 1.00 | 7.33 | 4.3556 | 1.81455 |
| | P2_Q8 | 30 | 1.33 | 7.33 | 4.8111 | 1.50779 |
| | Valid N (listwise) | 30 | | | | |
| np | P2_Q1 | 30 | 2.67 | 7.00 | 3.7889 | .96563 |
| | P2_Q2 | 30 | 1.00 | 5.33 | 2.9111 | 1.16768 |
| | P2_Q3 | 30 | 1.67 | 5.33 | 3.7556 | .95466 |
| | P2_Q4 | 30 | 2.00 | 6.33 | 3.8000 | .97713 |
| | P2_Q5 | 30 | 2.33 | 7.00 | 4.6000 | 1.27877 |
| | P2_Q6 | 30 | 3.33 | 7.33 | 5.3222 | 1.30276 |
| | P2_Q7 | 30 | 3.00 | 8.00 | 5.2111 | 1.45028 |
| | P2_Q8 | 30 | 2.67 | 8.67 | 5.1667 | 1.44834 |
| | Valid N (listwise) | 30 | | | | |

## Appendix 3

## Study 2 Assessment Instruments and SPSS Outputs

## Appendix 3.1

## End of Sequence assessment instrument (with personality questionnaires)

University of Chichester

**Thank you for agreeing to take part in this study.**

<u>Introduction and Rationale</u>

In the current study we are interested in how people make judgements about the abilities of the individuals they observe when playing and coaching. In this experiment we will be asking you to observe an ultimate frisbee player perform a series of the same skill, which involves the player cutting towards the disc, making a catch, pivoting, and making a forehand pass to a team-mate on the run. You will then be asked to rate his performance and ability. There is no right or wrong answer, just your own impression that is important.

All information you provide will be treated in the strictest of confidence.

All information you provide will be treated in the strictest of confidence.

Name: ____________________________________________

Age: _______________

Ethnic Origin: ______________________

Ultimate playing experience: ___________ (years)

(EOS – PN – A1)

**CONSENT FORM**

I, .................................................... (PRINT NAME)
hereby give my consent to participate in the following test/activity **[investigating impressions of ability in sport].**

By signing this form I confirm that:

- the purpose of the test/activity has been explained to me;
- I am satisfied that I understand the procedures involved;
- the possible benefits and risks of the test/activity have been explained to me;
- any questions which I have asked about the test/activity have been answered to my satisfaction;
- I understand that, during the course of the test/activity, I have the right to ask further questions about it;
- the information which I have supplied to University of Chichester prior to taking part in the test/activity is true and accurate to the best of my knowledge and belief and I understand that I must notify promptly of any changes to the information;
- I understand that my personal information will not be released to any third parties without my permission;
- I understand that my participation in the test/activity is voluntary and I am therefore at liberty to withdraw my involvement at any stage;
- I understand that, if there is any concern about the appropriateness of my continuing in the test/activity, I may be asked to withdraw my involvement at any stage;
- I understand that once the test/activity has been completed, the information gained as a result of it will be used for the following purposes only: **[To explore the way people make impressions of the sporting ability of others].**

SIGNATURE OF THE SUBJECT .......................................

DATE ..............................................

**Evaluation of Player 1**

On a scale of 1 (poor) to 10 (excellent), please rate the ultimate player for the following four criteria. Please circle the number that you feel best rates the player.

Ultimate Ability (general)

| Poor | | | | | | | | | Excellent |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |

Disc control

| Poor | | | | | | | | | Excellent |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |

Speed of Thought

| Poor | | | | | | | | | Excellent |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |

Athleticism

| Poor | | | | | | | | | Excellent |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |

**Evaluation of Player 2**

On a scale of 1 (poor) to 10 (excellent), please rate the ultimate player for the following four criteria. Please circle the number that you feel best rates the player.

Ultimate Ability (general)

| Poor | | | | | | | | | Excellent |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |

Disc control

| Poor | | | | | | | | | Excellent |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |

Speed of Thought

| Poor | | | | | | | | | Excellent |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |

Athleticism

| Poor | | | | | | | | | Excellent |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |

**On a scale of 1 (extremely uncharacteristic) to 5 (extremely characteristic), please circle the number that closest matches your own beliefs.**

1) I would prefer complex to simple problems.

| Extremely Uncharacteristic | | Uncertain | | Extremely Characteristic |
|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 |

2) I like to have the responsibility of handling a situation that requires a lot of thinking.

| Extremely Uncharacteristic | | Uncertain | | Extremely Characteristic |
|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 |

3) Thinking is not my idea of fun.

| Extremely Uncharacteristic | | Uncertain | | Extremely Characteristic |
|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 |

4) I would rather do something that requires little thought than something that is sure to challenge my thinking abilities.

| Extremely Uncharacteristic | | Uncertain | | Extremely Characteristic |
|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 |

5) I try to anticipate and avoid situations where there is likely a chance I will have to think i depth about something.

| Extremely Uncharacteristic | | Uncertain | | Extremely Characteristic |
|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 |

6) I find satisfaction in deliberating hard and for long hours.

| Extremely Uncharacteristic | | Uncertain | | Extremely Characteristic |
|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 |

7) I only think as hard as I have to.

| Extremely Uncharacteristic | | | Uncertain | | Extremely Characteristic |
|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | |

8) I prefer to think about small, daily projects to long-term ones.

| Extremely Uncharacteristic | | | Uncertain | | Extremely Characteristic |
|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | |

9) I like tasks that require little thought once I've learned them.

| Extremely Uncharacteristic | | | Uncertain | | Extremely Characteristic |
|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | |

10) The idea of relying on thought to make my way to the top appeals to me.

| Extremely Uncharacteristic | | | Uncertain | | Extremely Characteristic |
|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | |

11) I really enjoy a task that involves coming up with new solutions to problems.

| Extremely Uncharacteristic | | | Uncertain | | Extremely Characteristic |
|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | |

12) Learning new ways to think doesn't excite me very much.

| Extremely Uncharacteristic | | | Uncertain | | Extremely Characteristic |
|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | |

13) I prefer my life to be filled with puzzles that I must solve.

| Extremely Uncharacteristic | | Uncertain | | Extremely Characteristic |
|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 |

14) The notion of thinking abstractly is appealing to me.

| Extremely Uncharacteristic | | Uncertain | | Extremely Characteristic |
|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 |

15) I would prefer a task that is intellectual, difficult, and important to one that is somewhat important but does not require much thought.

| Extremely Uncharacteristic | | Uncertain | | Extremely Characteristic |
|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 |

16) I feel relief rather than satisfaction after completing a task that required a lot of mental effort.

| Extremely Uncharacteristic | | Uncertain | | Extremely Characteristic |
|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 |

17) It's enough for me that something gets the job done; I don't care how or why it works.

| Extremely Uncharacteristic | | Uncertain | | Extremely Characteristic |
|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 |

18) I usually end up deliberating about issues even when they do not affect me personally.

| Extremely Uncharacteristic | | Uncertain | | Extremely Characteristic |
|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 |

**On a scale of 1 (strongly disagree) to 6 (strongly agree), please circle the number that closest matches your own beliefs.**

1) Everyone has a certain amount of sporting/ultimate ability, and one can't do much to change this amount.

| Strongly disagree | | | | | Strongly agree |
|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 |

2) One's sporting/ultimate ability is something about oneself that one can't change much.

| Strongly disagree | | | | | Strongly agree |
|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 |

3) People can learn new things in sport/ultimate, but they can't change their basic sporting/ultimate ability.

| Strongly disagree | | | | | Strongly agree |
|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 |

## Appendix 3.2

## SPSS Outputs (Study 2)

# Descriptive Statistics (Study 2)

**Statistics**

gender

| | | |
|---|---|---|
| N | Valid | 160 |
| | Missing | 0 |

**gender**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | male | 97 | 60.6 | 60.6 | 60.6 |
| | female | 63 | 39.4 | 39.4 | 100.0 |
| | Total | 160 | 100.0 | 100.0 | |

**Descriptive Statistics**

| | N | Minimum | Maximum | Mean | Std. Deviation |
|---|---|---|---|---|---|
| age | 160 | 16.00 | 37.00 | 22.7625 | 3.78093 |
| Valid N (listwise) | 160 | | | | |

**THEORY OF LEARNING BELIEFS**

**Descriptive Statistics**

| | N | Minimum | Maximum | Mean | Std. Deviation |
|---|---|---|---|---|---|
| Entity_overall | 160 | 1.00 | 6.00 | 2.9895 | 1.06830 |
| Valid N (listwise) | 160 | | | | |

**NEED FOR COGNITION/MOTIVATION TO THINK**

**Descriptive Statistics**

| | N | Minimum | Maximum | Mean | Std. Deviation |
|---|---|---|---|---|---|
| NFC_total | 160 | 45.00 | 82.00 | 65.6500 | 8.16435 |
| Valid N (listwise) | 160 | | | | |

**Group Statistics**

| | high_low_NFC | N | Mean | Std. Deviation | Std. Error Mean |
|---|---|---|---|---|---|
| NFC_total | highNFC >66 | 79 | 72.3165 | 4.72729 | .53186 |
| | low NFC <65 | 81 | 59.1481 | 4.89926 | .54436 |

**Independent Samples Test**

| | | Levene's Test for Equality of Variances | | t-test for Equality of Means | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | 95% Confidence Interval of the Difference | |
| | | F | Sig. | t | df | Sig. (2-tailed) | Mean Difference | Std. Error Difference | Lower | Upper |
| NFC_total | Equal variances assumed | .283 | .596 | 17.295 | 158 | .000 | 13.16831 | .76140 | 11.6644 | 14.67214 |
| | Equal variances not assumed | | | 17.303 | 157.98 | .000 | 13.16831 | .76106 | 11.6651 | 14.67147 |

**EXPERIENCE**

**Descriptive Statistics**

| | N | Minimum | Maximum | Mean | Std. Deviation |
|---|---|---|---|---|---|
| experience | 160 | .25 | 20.00 | 3.5297 | 2.95343 |
| Valid N (listwise) | 160 | | | | |

**Group Statistics**

| | Experience_high_low | N | Mean | Std. Deviation | Std. Error Mean |
|---|---|---|---|---|---|
| experience | 2.9_or_below | 80 | 1.6656 | .65234 | .07293 |
| | 3.0_or_above | 80 | 5.3938 | 3.17695 | .35519 |

**Independent Samples Test**

| | | Levene's Test for Equality of Variances | | t-test for Equality of Means | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | 95% Confidence Interval of the Difference | |
| | | F | Sig. | t | df | Sig. (2-tailed) | Mean Difference | Std. Error Difference | Lower | Upper |
| experience | Equal variances assumed | 55.833 | .000 | -10.282 | 158 | .000 | -3.72812 | .36260 | -4.44430 | -3.01195 |
| | Equal variances not assumed | | | -10.282 | 85.650 | .000 | -3.72812 | .36260 | -4.44900 | -3.00725 |

## Correlations between subscales (Study 2)

**Correlations**

| | | P1_ultimate_ ability | P1_disc_ control | P1_speed_of_ thought | P1_athleticism |
|---|---|---|---|---|---|
| P1_ultimate_ ability | Pearson Correlation | 1.000 | .794** | .730** | .617** |
| | Sig. (2-tailed) | | .000 | .000 | .000 |
| | N | 160 | 160 | 160 | 160 |
| P1_disc_control | Pearson Correlation | .794** | 1.000 | .666** | .547** |
| | Sig. (2-tailed) | .000 | | .000 | .000 |
| | N | 160 | 160 | 159 | 159 |
| P1_speed_of_ thought | Pearson Correlation | .730** | .666** | 1.000 | .428** |
| | Sig. (2-tailed) | .000 | .000 | | .000 |
| | N | 160 | 160 | 160 | 160 |
| P1_athleticism | Pearson Correlation | .617** | .547** | .428** | 1.000 |
| | Sig. (2-tailed) | .000 | .000 | .000 | |
| | N | 160 | 160 | 160 | 160 |

**. Correlation is significant at the 0.01 level (2-tailed).

**Correlations**

| | | P2_ultimate_ ability | P2_disc_ control | P2_speed_of_ thought | P2_athleticism |
|---|---|---|---|---|---|
| P2_ultimate_ ability | Pearson Correlation | 1.000 | .808** | .752** | .676** |
| | Sig. (2-tailed) | | .000 | .000 | .000 |
| | N | 160 | 160 | 160 | 160 |
| P2_disc_control | Pearson Correlation | .808** | 1.000 | .704** | .497** |
| | Sig. (2-tailed) | .000 | | .000 | .000 |
| | N | 160 | 160 | 160 | 160 |
| P2_speed_of_ thought | Pearson Correlation | .752** | .704** | 1.000 | .556** |
| | Sig. (2-tailed) | .000 | .000 | | .000 |
| | N | 160 | 160 | 160 | 160 |
| P2_athleticism | Pearson Correlation | .676** | .497** | .556** | 1.000 |
| | Sig. (2-tailed) | .000 | .000 | .000 | |
| | N | 160 | 160 | 160 | 160 |

**. Correlation is significant at the 0.01 level (2-tailed).

).

## Reliability statistics (learning theory)

**Reliability Statistics**

| Cronbach's Alpha | N of Items |
|---|---|
| .814 | 3 |

**Item Statistics**

| | Mean | Std. Deviation | N |
|---|---|---|---|
| ENTITY1 | 3.0886 | 1.25368 | 158 |
| ENTITY2 | 2.5759 | 1.15264 | 158 |
| ENTITY3 | 3.2911 | 1.34640 | 158 |

**Item-Total Statistics**

| | Scale Mean if Item Deleted | Scale Variance if Item Deleted | Corrected Item-Total Correlation | Cronbach's Alpha if Item Deleted |
|---|---|---|---|---|
| ENTITY1 | 5.8671 | 4.906 | .690 | .719 |
| ENTITY2 | 6.3797 | 5.384 | .673 | .743 |
| ENTITY3 | 5.6646 | 4.734 | .642 | .775 |

**Scale Statistics**

| Mean | Variance | Std. Deviation | N of Items |
|---|---|---|---|
| 8.9557 | 10.310 | 3.21094 | 3 |

## ANCOVA assumptions (learning theory)

**Between-Subjects Factors**

| sbs_eos | | | Value Label | N |
|---|---|---|---|---|
| EOS | pn_np | 1.00 | pn | 40 |
| | | 2.00 | np | 40 |
| | entity_incre | 1.00 | incremental | 40 |
| | | 2.00 | entity | 40 |
| SBS | pn_np | 1.00 | pn | 40 |
| | | 2.00 | np | 40 |
| | entity_incre | 1.00 | incremental | 40 |
| | | 2.00 | entity | 40 |

**Descriptive Statistics**

Dependent Variable: UA_DC_SoT_player1

| sbs_eos | pn_np | entity_incre | Mean | Std. Deviation | N |
|---|---|---|---|---|---|
| EOS | pn | incremental | 6.5833 | .89145 | 24 |
| | | entity | 6.7917 | .83333 | 16 |
| | | Total | 6.6667 | .86397 | 40 |
| | np | incremental | 6.8333 | 1.12875 | 16 |
| | | entity | 6.4722 | .91639 | 24 |
| | | Total | 6.6167 | 1.00865 | 40 |
| | Total | incremental | 6.6833 | .98695 | 40 |
| | | entity | 6.6000 | .88739 | 40 |
| | | Total | 6.6417 | .93348 | 80 |
| SBS | pn | incremental | 6.6970 | .72673 | 22 |
| | | entity | 6.0741 | 1.20215 | 18 |
| | | Total | 6.4167 | 1.00639 | 40 |
| | np | incremental | 6.6078 | 1.38060 | 18 |
| | | entity | 6.3939 | 1.27506 | 22 |
| | | Total | 6.4872 | 1.30864 | 40 |
| | Total | incremental | 6.6581 | 1.04710 | 40 |
| | | entity | 6.2500 | 1.23747 | 40 |
| | | Total | 6.4515 | 1.15844 | 80 |

**Levene's Test of Equality of Error Variances(a)**

Dependent Variable: UA_DC_SoT_player1

| sbs_eos | F | df1 | df2 | Sig. |
|---|---|---|---|---|

| | | | | |
|---|---|---|---|---|
| EOS | .551 | 3 | 76 | .649 |
| SBS | 2.730 | 3 | 75 | .170 |

Tests the null hypothesis that the error variance of the dependent variable is equal across groups.
a Design: Intercept+pn_np+entity_incre+pn_np * entity_incre

**Tests of Between-Subjects Effects**

Dependent Variable: UA_DC_SoT_player1

| sbs_eos | Source | Type III Sum of Squares | df | Mean Square | F | Sig. | Partial Eta Squared | Noncent. Parameter | Observed Power(a) |
|---|---|---|---|---|---|---|---|---|---|
| EOS | Corrected Model | 1.719(b) | 3 | .573 | .649 | .586 | .025 | 1.946 | .180 |
| | Intercept | 3416.890 | 1 | 3416.89 | 3868.92 | .000 | .981 | 3868.924 | 1.000 |
| | pn_np | .023 | 1 | .023 | .026 | .872 | .000 | .026 | .053 |
| | entity_incre | .112 | 1 | .112 | .127 | .723 | .002 | .127 | .064 |
| | pn_np * entity_incre | 1.556 | 1 | 1.556 | 1.762 | .188 | .023 | 1.762 | .259 |
| | Error | 67.120 | 76 | .883 | | | | | |
| | Total | 3597.778 | 80 | | | | | | |
| | Corrected Total | 68.839 | 79 | | | | | | |
| SBS | Corrected Model | 4.378(c) | 3 | 1.459 | 1.091 | .358 | .042 | 3.274 | .284 |
| | Intercept | 3235.640 | 1 | 3235.64 | 2419.54 | .000 | .970 | 2419.545 | 1.000 |
| | pn_np | .259 | 1 | .259 | .194 | .661 | .003 | .194 | .072 |
| | entity_incre | 3.411 | 1 | 3.411 | 2.551 | .114 | .033 | 2.551 | .351 |
| | pn_np * entity_incre | .815 | 1 | .815 | .609 | .438 | .008 | .609 | .120 |
| | Error | 100.297 | 75 | 1.337 | | | | | |
| | Total | 3392.778 | 79 | | | | | | |
| | Corrected Total | 104.675 | 78 | | | | | | |

a Computed using alpha = .05
b R Squared = .025 (Adjusted R Squared = -.014)
c R Squared = .042 (Adjusted R Squared = .003)

## Order/learning theory interactions (EoS and SbS).

### COMBINED CONSTRUCT

**Between-Subjects Factors**

| sbs_eos | | | Value Label | N |
|---|---|---|---|---|
| EOS | pn_np | 1 | pn | 32 |
| | | 2 | np | 35 |
| | Dweck_entity | 1 | <_3incremental | 48 |
| | | 2 | >4_entity | 19 |
| SBS | pn_np | 1 | pn | 33 |
| | | 2 | np | 30 |
| | Dweck_entity | 1 | <_3incremental | 43 |
| | | 2 | >4_entity | 20 |

**Descriptive Statistics**

Dependent Variable:UA_DC_SoT_P2_average

| sbs_ eos | pn_np | Dweck_entity | Mean | Std. Deviation | N |
|---|---|---|---|---|---|
| EOS | pn | <_3incremental | 5.6933 | 1.07978 | 25 |
| | | >4_entity | 6.2381 | .80999 | 7 |
| | | Total | 5.8125 | 1.04019 | 32 |
| | np | <_3incremental | 4.9565 | .97600 | 23 |
| | | >4_entity | 5.1392 | 1.08687 | 12 |
| | | Total | 5.0191 | 1.00314 | 35 |
| | Total | <_3incremental | 5.3403 | 1.08610 | 48 |
| | | >4_entity | 5.5440 | 1.11230 | 19 |
| | | Total | 5.3981 | 1.08904 | 67 |
| SBS | pn | <_3incremental | 4.9394 | 1.25835 | 22 |
| | | >4_entity | 4.6361 | 1.62251 | 11 |
| | | Total | 4.8383 | 1.37219 | 33 |
| | np | <_3incremental | 4.9208 | 1.28191 | 21 |
| | | >4_entity | 5.1815 | 2.06902 | 9 |
| | | Total | 5.0890 | 1.54355 | 30 |
| | Total | <_3incremental | 4.9303 | 1.25473 | 43 |
| | | >4_entity | 5.0165 | 1.83690 | 20 |
| | | Total | 4.9577 | 1.44988 | 63 |

**Levene's Test of Equality of Error Variances[a]**

Dependent Variable:UA_DC_SoT_P2_average

| sbs_eos | F | df1 | df2 | Sig. |
|---|---|---|---|---|
| EOS | 1.470 | 3 | 63 | .231 |
| SBS | .186 | 3 | 59 | .905 |

Tests the null hypothesis that the error variance of the dependent variable is equal across groups.

a. Design: Intercept + UA_DC_SoT_player1 + pn_np + Dweck_entity + pn_np * Dweck_entity

**Tests of Between-Subjects Effects**

Dependent Variable:UA_DC_SoT_P2_average

| sbs_eos | Source | Type III Sum of Squares | df | Mean Square | F | Sig. | Partial Eta Squared | Noncent. Parameter | Observed Power[b] |
|---|---|---|---|---|---|---|---|---|---|
| EOS | Corrected Model | 19.273[a] | 4 | 4.818 | 5.063 | .001 | .246 | 20.252 | .952 |
| | Intercept | 12.725 | 1 | 12.725 | 13.371 | .001 | .177 | 13.371 | .949 |
| | UA_DC_SoT_player1 | 6.866 | 1 | 6.866 | 7.214 | .009 | .104 | 7.214 | .753 |
| | pn_np | 10.155 | 1 | 10.155 | 10.671 | .002 | .147 | 10.671 | .895 |
| | Dweck_entity | 1.200 | 1 | 1.200 | 1.261 | .266 | .020 | 1.261 | .198 |
| | pn_np * Dweck_entity | .164 | 1 | .164 | .172 | .680 | .003 | .172 | .069 |
| | Error | 59.004 | 62 | .952 | | | | | |
| | Total | 2030.593 | 67 | | | | | | |
| | Corrected Total | 78.277 | 66 | | | | | | |
| SBS | Corrected Model | 36.480[c] | 4 | 9.120 | 5.636 | .001 | .280 | 22.544 | .970 |
| | Intercept | 1.896 | 1 | 1.896 | 1.172 | .284 | .020 | 1.172 | .187 |
| | UA_DC_SoT_player1 | 32.837 | 1 | 32.837 | 20.292 | .000 | .259 | 20.292 | .993 |
| | pn_np | .842 | 1 | .842 | .521 | .473 | .009 | .521 | .109 |
| | Dweck_entity | 1.863 | 1 | 1.863 | 1.151 | .288 | .019 | 1.151 | .184 |
| | pn_np * Dweck_entity | .362 | 1 | .362 | .224 | .638 | .004 | .224 | .075 |
| | Error | 93.854 | 58 | 1.618 | | | | | |
| | Total | 1678.780 | 63 | | | | | | |
| | Corrected Total | 130.334 | 62 | | | | | | |

a. R Squared = .246 (Adjusted R Squared = .198)

b. Computed using alpha = .05

c. R Squared = .280 (Adjusted R Squared = .230)

## ATHLETICISM

**Between-Subjects Factors**

| sbs_eos | | | Value Label | N |
|---|---|---|---|---|
| EOS | pn_np | 1 | pn | 32 |
| | | 2 | np | 35 |
| | Dweck_entity | 1 | <_3incremental | 48 |
| | | 2 | >4_entity | 19 |
| SBS | pn_np | 1 | pn | 33 |
| | | 2 | np | 30 |
| | Dweck_entity | 1 | <_3incremental | 43 |
| | | 2 | >4_entity | 20 |

**Descriptive Statistics**

Dependent Variable:P2_athleticism

| sbs_eos | pn_np | Dweck_entity | Mean | Std. Deviation | N |
|---|---|---|---|---|---|
| EOS | pn | <_3incremental | 4.6000 | 1.32288 | 25 |
| | | >4_entity | 5.1429 | .89974 | 7 |
| | | Total | 4.7188 | 1.25040 | 32 |
| | np | <_3incremental | 4.6522 | .93462 | 23 |
| | | >4_entity | 4.8333 | 1.11464 | 12 |
| | | Total | 4.7143 | .98731 | 35 |
| | Total | <_3incremental | 4.6250 | 1.14157 | 48 |
| | | >4_entity | 4.9474 | 1.02598 | 19 |
| | | Total | 4.7164 | 1.11200 | 67 |
| SBS | pn | <_3incremental | 4.5000 | 1.26303 | 22 |
| | | >4_entity | 4.4545 | 1.50756 | 11 |
| | | Total | 4.4848 | 1.32574 | 33 |
| | np | <_3incremental | 4.7619 | 1.33809 | 21 |
| | | >4_entity | 5.5556 | 1.23603 | 9 |
| | | Total | 5.0000 | 1.33907 | 30 |
| | Total | <_3incremental | 4.6279 | 1.29142 | 43 |
| | | >4_entity | 4.9500 | 1.46808 | 20 |
| | | Total | 4.7302 | 1.34652 | 63 |

**Levene's Test of Equality of Error Variances[a]**

Dependent Variable:P2_athleticism

| sbs_eos | F | df1 | df2 | Sig. |
|---|---|---|---|---|
| EOS | 1.339 | 3 | 63 | .270 |
| SBS | .611 | 3 | 59 | .611 |

Tests the null hypothesis that the error variance of the dependent variable is equal across groups.

a. Design: Intercept + P1_athleticism + pn_np + Dweck_entity + pn_np * Dweck_entity

**Tests of Between-Subjects Effects**

Dependent Variable:P2_athleticism

| sbs_eos | Source | Type III Sum of Squares | df | Mean Square | F | Sig. | Partial Eta Squared | Noncent. Parameter | Observed Power[b] |
|---|---|---|---|---|---|---|---|---|---|
| EOS | Corrected Model | 3.661[a] | 4 | .915 | .728 | .576 | .045 | 2.912 | .222 |
| | Intercept | 25.729 | 1 | 25.729 | 20.464 | .000 | .248 | 20.464 | .994 |
| | P1_athleticism | 1.790 | 1 | 1.790 | 1.424 | .237 | .022 | 1.424 | .217 |
| | pn_np | .297 | 1 | .297 | .237 | .628 | .004 | .237 | .077 |
| | Dweck_entity | 1.710 | 1 | 1.710 | 1.360 | .248 | .021 | 1.360 | .209 |
| | pn_np * Dweck_entity | .327 | 1 | .327 | .260 | .612 | .004 | .260 | .079 |
| | Error | 77.951 | 62 | 1.257 | | | | | |
| | Total | 1572.000 | 67 | | | | | | |
| | Corrected Total | 81.612 | 66 | | | | | | |
| SBS | Corrected Model | 17.902[c] | 4 | 4.475 | 2.746 | .037 | .159 | 10.986 | .722 |
| | Intercept | 10.166 | 1 | 10.166 | 6.239 | .015 | .097 | 6.239 | .690 |
| | P1_athleticism | 9.748 | 1 | 9.748 | 5.982 | .018 | .093 | 5.982 | .672 |
| | pn_np | 4.121 | 1 | 4.121 | 2.529 | .117 | .042 | 2.529 | .346 |
| | Dweck_entity | 3.250 | 1 | 3.250 | 1.995 | .163 | .033 | 1.995 | .284 |
| | pn_np * Dweck_entity | 1.552 | 1 | 1.552 | .952 | .333 | .016 | .952 | .160 |
| | Error | 94.511 | 58 | 1.630 | | | | | |
| | Total | 1522.000 | 63 | | | | | | |
| | Corrected Total | 112.413 | 62 | | | | | | |

a. R Squared = .045 (Adjusted R Squared = -.017)

b. Computed using alpha = .05

c. R Squared = .159 (Adjusted R Squared = .101)

## Reliability statistics (motivation to think)

**Reliability Statistics**

| Cronbach's Alpha | N of Items |
|---|---|
| .790 | 18 |

**Item Statistics**

| | Mean | Std. Deviation | N |
|---|---|---|---|
| NC1 | 3.5220 | 1.01779 | 160 |
| NC2 | 3.8805 | .81415 | 160 |
| NC3 | 4.0000 | .89301 | 160 |
| NC4 | 3.9874 | .85675 | 160 |
| NC5 | 3.9937 | .83056 | 160 |
| NC6 | 3.1824 | 1.12427 | 160 |
| NC7 | 3.0252 | 1.06705 | 160 |
| NC8 | 3.1887 | 1.05644 | 160 |
| NC9 | 3.1321 | 1.09147 | 160 |
| NC10 | 3.7925 | .94852 | 160 |
| NC11 | 4.1824 | .71028 | 160 |
| NC12 | 4.0377 | .85600 | 160 |
| NC13 | 3.4717 | 1.00512 | 160 |
| NC14 | 3.7736 | 1.01211 | 160 |
| NC15 | 3.7044 | .93831 | 160 |
| NC16 | 3.5220 | 1.10715 | 160 |
| NC17 | 3.6478 | 1.07996 | 160 |
| NC18 | 3.6101 | .98670 | 160 |

**Item-Total Statistics**

| | Scale Mean if Item Deleted | Scale Variance if Item Deleted | Corrected Item-Total Correlation | Cronbach's Alpha if Item Deleted |
|---|---|---|---|---|
| NC1 | 62.1321 | 61.660 | .274 | .787 |
| NC2 | 61.7736 | 62.695 | .288 | .785 |
| NC3 | 61.6541 | 59.785 | .470 | .774 |
| NC4 | 61.6667 | 60.021 | .476 | .774 |
| NC5 | 61.6604 | 61.074 | .409 | .778 |
| NC6 | 62.4717 | 59.694 | .352 | .782 |
| NC7 | 62.6289 | 61.172 | .286 | .786 |
| NC8 | 62.4654 | 62.947 | .180 | .794 |
| NC9 | 62.5220 | 60.125 | .340 | .782 |
| NC10 | 61.8616 | 60.285 | .400 | .778 |
| NC11 | 61.4717 | 61.656 | .441 | .777 |
| NC12 | 61.6164 | 59.959 | .482 | .773 |
| NC13 | 62.1824 | 57.239 | .580 | .765 |
| NC14 | 61.8805 | 59.334 | .431 | .776 |
| NC15 | 61.9497 | 59.959 | .429 | .776 |
| NC16 | 62.1321 | 58.634 | .426 | .776 |
| NC17 | 62.0063 | 60.184 | .342 | .782 |
| NC18 | 62.0440 | 63.840 | .143 | .795 |

**Scale Statistics**

| Mean | Variance | Std. Deviation | N of Items |
|---|---|---|---|
| 65.6541 | 67.076 | 8.18998 | 18 |

## ANCOVA assumptions (motivation to think)

**Between-Subjects Factors**

| sbs_eos | | | Value Label | N |
|---|---|---|---|---|
| EOS | pn_np | 1.00 | pn | 40 |
| | | 2.00 | np | 40 |
| | high_low_NFC | 1.00 | highNFC >66 | 40 |
| | | 2.00 | low NFC <65 | 40 |
| SBS | pn_np | 1.00 | pn | 40 |
| | | 2.00 | np | 40 |
| | high_low_NFC | 1.00 | highNFC >66 | 39 |
| | | 2.00 | low NFC <65 | 41 |

**Descriptive Statistics**

Dependent Variable: UA_DC_SoT_player1

| sbs_eos | pn_np | high_low_NFC | Mean | Std. Deviation | N |
|---|---|---|---|---|---|
| EOS | pn | highNFC >66 | 6.5490 | .83284 | 17 |
| | | low NFC <65 | 6.7536 | .89453 | 23 |
| | | Total | 6.6667 | .86397 | 40 |
| | np | highNFC >66 | 6.4203 | .94397 | 23 |
| | | low NFC <65 | 6.8824 | 1.06027 | 17 |
| | | Total | 6.6167 | 1.00865 | 40 |
| | Total | highNFC >66 | 6.4750 | .88960 | 40 |
| | | low NFC <65 | 6.8083 | .95746 | 40 |
| | | Total | 6.6417 | .93348 | 80 |
| SBS | pn | highNFC >66 | 6.1884 | 1.01914 | 23 |
| | | low NFC <65 | 6.7255 | .92972 | 17 |
| | | Total | 6.4167 | 1.00639 | 40 |
| | np | highNFC >66 | 6.6458 | 1.37958 | 16 |
| | | low NFC <65 | 6.3611 | 1.25076 | 24 |
| | | Total | 6.4750 | 1.29405 | 40 |
| | Total | highNFC >66 | 6.3761 | 1.18514 | 39 |
| | | low NFC <65 | 6.5122 | 1.13063 | 41 |
| | | Total | 6.4458 | 1.15219 | 80 |

**Levene's Test of Equality of Error Variances(a)**

Dependent Variable: UA_DC_SoT_player1

| sbs_eos | F | df1 | df2 | Sig. |
|---|---|---|---|---|
| EOS | .255 | 3 | 76 | .858 |
| SBS | 1.466 | 3 | 76 | .231 |

Tests the null hypothesis that the error variance of the dependent variable is equal across groups.
a Design: Intercept+pn_np+high_low_NFC+pn_np * high_low_NFC

**Tests of Between-Subjects Effects**

Dependent Variable: UA_DC_SoT_player1

| sbs_eos | Source | Type III Sum of Squares | df | Mean Square | F | Sig. | Partial Eta Squared | Noncent. Parameter | Observed Power(a) |
|---|---|---|---|---|---|---|---|---|---|
| EOS | Corrected Model | 2.546(b) | 3 | .849 | .973 | .410 | .037 | 2.919 | .256 |
| | Intercept | 3459.574 | 1 | 3459.6 | 3966.16 | .000 | .981 | 3966.163 | 1.000 |
| | pn_np | .000 | 1 | .000 | .000 | 1.000 | .000 | .000 | .050 |
| | high_low_NFC | 2.172 | 1 | 2.172 | 2.490 | .119 | .032 | 2.490 | .344 |
| | pn_np * high_low_NFC | .324 | 1 | .324 | .371 | .544 | .005 | .371 | .092 |
| | Error | 66.293 | 76 | .872 | | | | | |
| | Total | 3597.778 | 80 | | | | | | |
| | Corrected Total | 68.839 | 79 | | | | | | |
| SBS | Corrected Model | 3.666(c) | 3 | 1.222 | .918 | .437 | .035 | 2.753 | .243 |
| | Intercept | 3254.202 | 1 | 3254.2 | 2443.61 | .000 | .970 | 2443.616 | 1.000 |
| | pn_np | .042 | 1 | .042 | .031 | .860 | .000 | .031 | .054 |
| | high_low_NFC | .308 | 1 | .308 | .232 | .632 | .003 | .232 | .076 |
| | pn_np * high_low_NFC | 3.271 | 1 | 3.271 | 2.456 | .121 | .031 | 2.456 | .340 |
| | Error | 101.210 | 76 | 1.332 | | | | | |
| | Total | 3428.778 | 80 | | | | | | |
| | Corrected Total | 104.876 | 79 | | | | | | |

a Computed using alpha = .05
b R Squared = .037 (Adjusted R Squared = -.001)
c R Squared = .035 (Adjusted R Squared = -.003)

## Order/motivation to think interactions (EoS and SbS)

### COMBINED CONSTRUCT

**Between-Subjects Factors**

| sbs_eos | | | Value Label | N |
|---|---|---|---|---|
| EOS | pn_np | 1.00 | pn | 40 |
| | | 2.00 | np | 40 |
| | high_low_NFC | 1.00 | highNFC >66 | 40 |
| | | 2.00 | low NFC <65 | 40 |
| SBS | pn_np | 1.00 | pn | 40 |
| | | 2.00 | np | 40 |
| | high_low_NFC | 1.00 | highNFC >66 | 39 |
| | | 2.00 | low NFC <65 | 41 |

**Levene's Test of Equality of Error Variances(a)**

Dependent Variable: UA_DC_SoT_P2_average

| sbs_eos | F | df1 | df2 | Sig. |
|---|---|---|---|---|
| EOS | .632 | 3 | 76 | .597 |
| SBS | .504 | 3 | 76 | .681 |

Tests the null hypothesis that the error variance of the dependent variable is equal across groups.
a Design: Intercept+UA_DC_SoT_player1+pn_np+high_low_NFC+pn_np * high_low_NFC

**Descriptive Statistics**

Dependent Variable: UA_DC_SoT_P2_average

| sbs_eos | pn_np | high_low_NFC | Mean | Std. Deviation | N |
|---|---|---|---|---|---|
| EOS | pn | highNFC >66 | 6.0196 | 1.05719 | 17 |
| | | low NFC <65 | 5.5217 | .97352 | 23 |
| | | Total | 5.7333 | 1.02726 | 40 |
| | np | highNFC >66 | 4.7826 | .96195 | 23 |
| | | low NFC <65 | 5.3531 | .98234 | 17 |
| | | Total | 5.0251 | .99973 | 40 |
| | Total | highNFC >66 | 5.3083 | 1.16792 | 40 |
| | | low NFC <65 | 5.4501 | .96832 | 40 |
| | | Total | 5.3792 | 1.06834 | 80 |
| SBS | pn | highNFC >66 | 4.7972 | 1.40251 | 23 |
| | | low NFC <65 | 4.8625 | 1.14306 | 17 |
| | | Total | 4.8250 | 1.28324 | 40 |
| | np | highNFC >66 | 4.2708 | .87955 | 16 |
| | | low NFC <65 | 5.4725 | 1.31104 | 24 |
| | | Total | 4.9918 | 1.29099 | 40 |
| | Total | highNFC >66 | 4.5813 | 1.23003 | 39 |
| | | low NFC <65 | 5.2196 | 1.26630 | 41 |
| | | Total | 4.9084 | 1.28170 | 80 |

**Tests of Between-Subjects Effects**

Dependent Variable: UA_DC_SoT_P2_average

| sbs_eos | Source | Type III Sum of Squares | df | Mean Square | F | Sig. | Partial Eta Squared | Noncent. Parameter | Observed Power(a) |
|---|---|---|---|---|---|---|---|---|---|
| EOS | Corrected Model | 21.620(b) | 4 | 5.405 | 5.914 | .000 | .240 | 23.655 | .979 |
| | Intercept | 17.209 | 1 | 17.209 | 18.829 | .000 | .201 | 18.829 | .990 |
| | UA_DC_SoT_player1 | 5.982 | 1 | 5.982 | 6.546 | .013 | .080 | 6.546 | .714 |
| | pn_np | 9.656 | 1 | 9.656 | 10.565 | .002 | .123 | 10.565 | .894 |
| | high_low_NFC | .077 | 1 | .077 | .084 | .772 | .001 | .084 | .059 |
| | pn_np * high_low_NFC | 4.777 | 1 | 4.777 | 5.227 | .025 | .065 | 5.227 | .617 |
| | Error | 68.548 | 75 | .914 | | | | | |
| | Total | 2405.038 | 80 | | | | | | |
| | Corrected Total | 90.167 | 79 | | | | | | |
| SBS | Corrected Model | 33.508(c) | 4 | 8.377 | 6.526 | .000 | .258 | 26.105 | .988 |
| | Intercept | 9.723 | 1 | 9.723 | 7.575 | .007 | .092 | 7.575 | .775 |
| | UA_DC_SoT_player1 | 19.048 | 1 | 19.048 | 14.839 | .000 | .165 | 14.839 | .967 |
| | pn_np | .009 | 1 | .009 | .007 | .933 | .000 | .007 | .051 |
| | high_low_NFC | 6.469 | 1 | 6.469 | 5.040 | .028 | .063 | 5.040 | .601 |
| | pn_np * high_low_NFC | 10.456 | 1 | 10.456 | 8.146 | .006 | .098 | 8.146 | .804 |
| | Error | 96.270 | 75 | 1.284 | | | | | |
| | Total | 2057.182 | 80 | | | | | | |
| | Corrected Total | 129.778 | 79 | | | | | | |

a Computed using alpha = .05
b R Squared = .240 (Adjusted R Squared = .199)
c R Squared = .258 (Adjusted R Squared = .219

## ATHLETICISM

**Between-Subjects Factors**

| sbs_eos | | | Value Label | N |
|---|---|---|---|---|
| EOS | pn_np | 1 | pn | 40 |
| | | 2 | np | 40 |
| | high_low_NFC | 1 | highNFC >66 | 40 |
| | | 2 | low NFC <65 | 40 |
| SBS | pn_np | 1 | pn | 40 |
| | | 2 | np | 40 |
| | high_low_NFC | 1 | highNFC >66 | 40 |
| | | 2 | low NFC <65 | 40 |

**Descriptive Statistics**

Dependent Variable:P2_athleticism

| sbs_eos | pn_np | high_low_NFC | Mean | Std. Deviation | N |
|---|---|---|---|---|---|
| EOS | pn | highNFC >66 | 4.5294 | 1.37467 | 17 |
| | | low NFC <65 | 4.7391 | 1.35571 | 23 |
| | | Total | 4.6500 | 1.35021 | 40 |
| | np | highNFC >66 | 4.4783 | .99405 | 23 |
| | | low NFC <65 | 5.0588 | .96635 | 17 |
| | | Total | 4.7250 | 1.01242 | 40 |
| | Total | highNFC >66 | 4.5000 | 1.15470 | 40 |
| | | low NFC <65 | 4.8750 | 1.20229 | 40 |
| | | Total | 4.6875 | 1.18635 | 80 |
| SBS | pn | highNFC >66 | 4.3043 | 1.42812 | 23 |
| | | low NFC <65 | 4.5294 | 1.06757 | 17 |
| | | Total | 4.4000 | 1.27702 | 40 |
| | np | highNFC >66 | 4.2500 | 1.00000 | 16 |
| | | low NFC <65 | 4.9565 | 1.49174 | 24 |
| | | Total | 4.6667 | 1.34425 | 40 |
| | Total | highNFC >66 | 4.2821 | 1.25549 | 40 |
| | | low NFC <65 | 4.7750 | 1.32988 | 40 |
| | | Total | 4.5316 | 1.30909 | 80 |

**Levene's Test of Equality of Error Variances[a]**

Dependent Variable:P2_athleticism

| sbs_eos | F | df1 | df2 | Sig. |
|---|---|---|---|---|
| EOS | 1.896 | 3 | 76 | .137 |
| SBS | .961 | 3 | 76 | .416 |

Tests the null hypothesis that the error variance of the dependent variable is equal across groups.

a. Design: Intercept + P1_athleticism + pn_np + high_low_NFC + pn_np * high_low_NFC

**Tests of Between-Subjects Effects**

Dependent Variable:P2_athleticism

| sbs_eos | Source | Type III Sum of Squares | df | Mean Square | F | Sig. | Partial Eta Squared | Noncent. Parameter | Observed Power[b] |
|---|---|---|---|---|---|---|---|---|---|
| EOS | Corrected Model | 5.423[a] | 4 | 1.356 | .961 | .434 | .049 | 3.845 | .291 |
| | Intercept | 30.439 | 1 | 30.439 | 21.585 | .000 | .223 | 21.585 | .996 |
| | P1_athleticism | 1.586 | 1 | 1.586 | 1.125 | .292 | .015 | 1.125 | .182 |
| | pn_np | .279 | 1 | .279 | .198 | .658 | .003 | .198 | .072 |
| | high_low_NFC | 2.550 | 1 | 2.550 | 1.808 | .183 | .024 | 1.808 | .264 |
| | pn_np * high_low_NFC | .770 | 1 | .770 | .546 | .462 | .007 | .546 | .113 |
| | Error | 105.765 | 75 | 1.410 | | | | | |
| | Total | 1869.000 | 80 | | | | | | |
| | Corrected Total | 111.187 | 79 | | | | | | |
| SBS | Corrected Model | 21.886[c] | 4 | 5.472 | 3.622 | .009 | .164 | 14.489 | .855 |
| | Intercept | 6.659 | 1 | 6.659 | 4.408 | .039 | .056 | 4.408 | .545 |
| | P1_athleticism | 15.277 | 1 | 15.277 | 10.113 | .002 | .120 | 10.113 | .881 |
| | pn_np | .105 | 1 | .105 | .069 | .793 | .001 | .069 | .058 |
| | high_low_NFC | 2.965 | 1 | 2.965 | 1.963 | .165 | .026 | 1.963 | .282 |
| | pn_np * high_low_NFC | 2.878 | 1 | 2.878 | 1.905 | .172 | .025 | 1.905 | .276 |
| | Error | 111.784 | 75 | 1.511 | | | | | |
| | Total | 1756.000 | 80 | | | | | | |
| | Corrected Total | 133.671 | 79 | | | | | | |

a. R Squared = .049 (Adjusted R Squared = -.002)

b. Computed using alpha = .05

c. R Squared = .164 (Adjusted R Squared = .119)

## Post-hoc tests (motivation to think).

## COMBINED CONSTRUCT

**Group Statistics**

| sbs_eos | high_low_NFC | | pn_np | N | Mean | Std. Deviation | Std. Error Mean |
|---|---|---|---|---|---|---|---|
| EOS | highNFC >66 | P2adjustedchange | Pn | 17 | -.5294 | 1.32318 | .32092 |
| | | | Np | 23 | -1.6377 | 1.00460 | .20947 |
| | low NFC <65 | P2adjustedchange | Pn | 23 | -1.2319 | 1.15223 | .24026 |
| | | | Np | 17 | -1.5292 | 1.16109 | .28160 |
| SBS | highNFC >66 | P2adjustedchange | Pn | 23 | -1.4781 | 1.35539 | .28262 |
| | | | Np | 17 | -1.9792 | 1.54665 | .38666 |
| | low NFC <65 | P2adjustedchange | Pn | 17 | -1.8629 | 1.04764 | .25409 |
| | | | Np | 23 | -1.1303 | 1.08564 | .22637 |

**Independent Samples Test**

| sbs_eos | high_low_NFC | | | Levene's Test for Equality of Variances F | Sig. | t-test for Equality of Means t | df | Sig. (2-tailed) | Mean Difference | Std. Error Difference | 95% Confidence Interval of the Difference Lower | Upper |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| EOS | high NFC | P2adjusted change | Equal variances assumed | 3.697 | .062 | 3.014 | 38 | .005 | 1.10827 | .36768 | .36394 | 1.85260 |
| | | | Equal variances not assumed | | | 2.892 | 28.74 | .007 | 1.10827 | .38323 | .32416 | 1.89238 |
| | low NFC | P2adjusted change | Equal variances assumed | .255 | .616 | .804 | 38 | .426 | .29733 | .36973 | -.45115 | 1.04581 |
| | | | Equal variances not assumed | | | .803 | 34.48 | .427 | .29733 | .37017 | -.45455 | 1.04922 |
| SBS | high NFC | P2adjusted change | Equal variances assumed | .092 | .763 | 1.072 | 38 | .291 | .50105 | .46748 | -.44615 | 1.44826 |
| | | | Equal variances not assumed | | | 1.046 | 29.55 | .304 | .50105 | .47894 | -.47769 | 1.47979 |
| | low NFC | P2adjusted change | Equal variances assumed | .262 | .612 | -2.14 | 38 | .039 | -.73265 | .34217 | -1.4253 | -.03996 |
| | | | Equal variances not assumed | | | -2.15 | 35.30 | .038 | -.73265 | .34030 | -1.4233 | -.04201 |

## ANCOVA assumptions (level of experience)

**Between-Subjects Factors**

| sbs_eos | | | Value Label | N |
|---|---|---|---|---|
| EOS | pn_np | 1.00 | Pn | 40 |
| | | 2.00 | Np | 40 |
| | Ex_high_low | 1.00 | 2.9_or_below | 39 |
| | | 2.00 | 3.0_or_above | 41 |
| SBS | pn_np | 1.00 | Pn | 40 |
| | | 2.00 | Np | 40 |
| | Ex_high_low | 1.00 | 2.9_or_below | 41 |
| | | 2.00 | 3.0_or_above | 39 |

**Descriptive Statistics**

Dependent Variable: UA_DC_SoT_player1

| sbs_eos | pn_np | Ex_high_low | Mean | Std. Deviation | N |
|---|---|---|---|---|---|
| EOS | pn | 2.9_or_below | 6.7667 | .97992 | 20 |
| | | 3.0_or_above | 6.5667 | .74221 | 20 |
| | | Total | 6.6667 | .86397 | 40 |
| | np | 2.9_or_below | 6.7368 | .75014 | 19 |
| | | 3.0_or_above | 6.5079 | 1.20471 | 21 |
| | | Total | 6.6167 | 1.00865 | 40 |
| | Total | 2.9_or_below | 6.7521 | .86423 | 39 |
| | | 3.0_or_above | 6.5366 | .99409 | 41 |
| | | Total | 6.6417 | .93348 | 80 |
| SBS | pn | 2.9_or_below | 6.7500 | .74829 | 20 |
| | | 3.0_or_above | 6.0833 | 1.13362 | 20 |
| | | Total | 6.4167 | 1.00639 | 40 |
| | np | 2.9_or_below | 6.9841 | 1.27138 | 21 |
| | | 3.0_or_above | 5.9123 | 1.09343 | 19 |
| | | Total | 6.4750 | 1.29405 | 40 |
| | Total | 2.9_or_below | 6.8699 | 1.04317 | 41 |
| | | 3.0_or_above | 6.0000 | 1.10289 | 39 |
| | | Total | 6.4458 | 1.15219 | 80 |

**Levene's Test of Equality of Error Variances(a)**

Dependent Variable: UA_DC_SoT_player1

| sbs_eos | F | df1 | df2 | Sig. |
|---|---|---|---|---|
| EOS | 3.015 | 3 | 76 | .115 |
| SBS | 2.273 | 3 | 76 | .087 |

Tests the null hypothesis that the error variance of the dependent variable is equal across groups.
a Design: Intercept+pn_np+Ex_high_low+pn_np * Ex_high_low

**Tests of Between-Subjects Effects**

Dependent Variable: UA_DC_SoT_player1

| sbs_eos | Source | Type III Sum of Squares | df | Mean Square | F | Sig. | Partial Eta Squared | Noncent. Parameter | Observed Power(a) |
|---|---|---|---|---|---|---|---|---|---|
| EOS | Corrected Model | .973(b) | 3 | .324 | .363 | .780 | .014 | 1.089 | .118 |
| | Intercept | 3527.560 | 1 | 3527.56 | 3950.33 | .000 | .981 | 3950.338 | 1.000 |
| | pn_np | .039 | 1 | .039 | .044 | .835 | .001 | .044 | .055 |
| | Ex_high_low | .919 | 1 | .919 | 1.029 | .314 | .013 | 1.029 | .170 |
| | pn_np * Ex_high_low | .004 | 1 | .004 | .005 | .946 | .000 | .005 | .051 |
| | Error | 67.866 | 76 | .893 | | | | | |
| | Total | 3597.778 | 80 | | | | | | |
| | Corrected Total | 68.839 | 79 | | | | | | |
| SBS | Corrected Model | 15.972(c) | 3 | 5.324 | 4.551 | .005 | .152 | 13.654 | .870 |
| | Intercept | 3305.955 | 1 | 3305.95 | 2826.11 | .000 | .974 | 2826.109 | 1.000 |
| | pn_np | .020 | 1 | .020 | .017 | .897 | .000 | .017 | .052 |
| | Ex_high_low | 15.093 | 1 | 15.093 | 12.903 | .001 | .145 | 12.903 | .944 |
| | pn_np * Ex_high_low | .820 | 1 | .820 | .701 | .405 | .009 | .701 | .131 |
| | Error | 88.904 | 76 | 1.170 | | | | | |
| | Total | 3428.778 | 80 | | | | | | |
| | Corrected Total | 104.876 | 79 | | | | | | |

a Computed using alpha = .05
b R Squared = .014 (Adjusted R Squared = -.025)
c R Squared = .152 (Adjusted R Squared = .119)

# Order/experience interaction (EoS and SbS).

## COMBINED CONSTRUCT

**Between-Subjects Factors**

| sbs_eos | | | Value Label | N |
|---|---|---|---|---|
| EOS | pn_np | 1 | pn | 40 |
| | | 2 | np | 40 |
| | Ex_high_low | 1 | 2.9_or_below | 39 |
| | | 2 | 3.0_or_above | 41 |
| SBS | pn_np | 1 | pn | 40 |
| | | 2 | np | 40 |
| | Ex_high_low | 1 | 2.9_or_below | 41 |
| | | 2 | 3.0_or_above | 39 |

**Descriptive Statistics**

Dependent Variable: UA_DC_SoT_P2_average

| sbs_eos | pn_np | Experience_high_low | Mean | Std. Deviation | N |
|---|---|---|---|---|---|
| EOS | pn | 2.9_or_below | 5.8833 | .98096 | 20 |
| | | 3.0_or_above | 5.5833 | 1.07538 | 20 |
| | | Total | 5.7333 | 1.02726 | 40 |
| | np | 2.9_or_below | 5.0353 | .78500 | 19 |
| | | 3.0_or_above | 5.0159 | 1.18075 | 21 |
| | | Total | 5.0251 | .99973 | 40 |
| | Total | 2.9_or_below | 5.4702 | .97849 | 39 |
| | | 3.0_or_above | 5.2927 | 1.15276 | 41 |
| | | Total | 5.3792 | 1.06834 | 80 |
| SBS | pn | 2.9_or_below | 4.7998 | 1.03401 | 20 |
| | | 3.0_or_above | 4.8502 | 1.51973 | 20 |
| | | Total | 4.8250 | 1.28324 | 40 |
| | np | 2.9_or_below | 5.6825 | 1.27574 | 21 |
| | | 3.0_or_above | 4.1933 | 1.04453 | 19 |
| | | Total | 4.9752 | 1.38037 | 40 |
| | Total | 2.9_or_below | 5.2520 | 1.23335 | 41 |
| | | 3.0_or_above | 4.5302 | 1.33500 | 39 |
| | | Total | 4.9001 | 1.32638 | 80 |

**Levene's Test of Equality of Error Variances(a)**

Dependent Variable: UA_DC_SoT_P2_average

| sbs_eos | F | df1 | df2 | Sig. |
|---|---|---|---|---|
| EOS | 1.894 | 3 | 76 | .138 |
| SBS | 1.227 | 3 | 76 | .306 |

Tests the null hypothesis that the error variance of the dependent variable is equal across groups.
a Design: Intercept+UA_DC_SoT_player1+pn_np+Experience_high_low+pn_np * Experience_high_low

**Tests of Between-Subjects Effects**

Dependent Variable: UA_DC_SoT_P2_average

| sbs_ eos | Source | Type III Sum of Squares | df | Mean Square | F | Sig. | Partial Eta Squared | Noncent. Parameter | Observed Power(a) |
|---|---|---|---|---|---|---|---|---|---|
| EOS | Corrected Model | 17.343(b) | 4 | 4.336 | 4.465 | .003 | .192 | 17.861 | .925 |
| | Intercept | 16.804 | 1 | 16.804 | 17.306 | .000 | .187 | 17.306 | .984 |
| | UA_DC_SoT_player1 | 6.406 | 1 | 6.406 | 6.598 | .012 | .081 | 6.598 | .718 |
| | pn_np | 9.620 | 1 | 9.620 | 9.907 | .002 | .117 | 9.907 | .874 |
| | Experience_high_low | .173 | 1 | .173 | .179 | .674 | .002 | .179 | .070 |
| | pn_np * Ex_high_low | .418 | 1 | .418 | .431 | .514 | .006 | .431 | .099 |
| | Error | 72.825 | 75 | .971 | | | | | |
| | Total | 2405.038 | 80 | | | | | | |
| | Corrected Total | 90.167 | 79 | | | | | | |
| SBS | Corrected Model | 43.531(c) | 4 | 10.883 | 8.551 | .000 | .313 | 34.204 | .998 |
| | Intercept | 6.483 | 1 | 6.483 | 5.094 | .027 | .064 | 5.094 | .606 |
| | UA_DC_SoT_player1 | 20.933 | 1 | 20.933 | 16.448 | .000 | .180 | 16.448 | .979 |
| | pn_np | .190 | 1 | .190 | .150 | .700 | .002 | .150 | .067 |
| | Experience_high_low | 1.513 | 1 | 1.513 | 1.189 | .279 | .016 | 1.189 | .190 |
| | pn_np * Ex_high_low | 8.924 | 1 | 8.924 | 7.012 | .010 | .085 | 7.012 | .743 |
| | Error | 95.452 | 75 | 1.273 | | | | | |
| | Total | 2059.849 | 80 | | | | | | |
| | Corrected Total | 138.984 | 79 | | | | | | |

a Computed using alpha = .05
b R Squared = .192 (Adjusted R Squared = .149)
c R Squared = .313 (Adjusted R Squared = .277)

## ATHLETICISM

**Between-Subjects Factors**

| sbs_eos | | | Value Label | N |
|---|---|---|---|---|
| EOS | pn_np | 1 | pn | 40 |
| | | 2 | np | 40 |
| | Experience_high_low | 1 | 2.9_or_below | 39 |
| | | 2 | 3.0_or_above | 41 |
| SBS | pn_np | 1 | pn | 40 |
| | | 2 | np | 40 |
| | Experience_high_low | 1 | 2.9_or_below | 41 |
| | | 2 | 3.0_or_above | 39 |

**Descriptive Statistics**

Dependent Variable:P2_athleticism

| sbs_eos | pn_np | Experience_high_low | Mean | Std. Deviation | N |
|---|---|---|---|---|---|
| EOS | pn | 2.9_or_below | 4.6500 | 1.46089 | 20 |
| | | 3.0_or_above | 4.6500 | 1.26803 | 20 |
| | | Total | 4.6500 | 1.35021 | 40 |
| | np | 2.9_or_below | 4.6316 | 1.01163 | 19 |
| | | 3.0_or_above | 4.8095 | 1.03049 | 21 |
| | | Total | 4.7250 | 1.01242 | 40 |
| | Total | 2.9_or_below | 4.6410 | 1.24578 | 39 |
| | | 3.0_or_above | 4.7317 | 1.14071 | 41 |
| | | Total | 4.6875 | 1.18635 | 80 |
| SBS | pn | 2.9_or_below | 4.2500 | 1.11803 | 20 |
| | | 3.0_or_above | 4.5500 | 1.43178 | 20 |
| | | Total | 4.4000 | 1.27702 | 40 |
| | np | 2.9_or_below | 5.1429 | 1.27615 | 21 |
| | | 3.0_or_above | 4.1111 | 1.23140 | 19 |
| | | Total | 4.6667 | 1.34425 | 40 |
| | Total | 2.9_or_below | 4.7073 | 1.26972 | 41 |
| | | 3.0_or_above | 4.3421 | 1.34116 | 39 |
| | | Total | 4.5316 | 1.30909 | 80 |

**Levene's Test of Equality of Error Variances[a]**

Dependent Variable:P2_athleticism

| sbs_eos | F | df1 | df2 | Sig. |
|---|---|---|---|---|
| EOS | 2.040 | 3 | 76 | .115 |
| SBS | .216 | 3 | 76 | .885 |

Tests the null hypothesis that the error variance of the dependent variable is equal across groups.

a. Design: Intercept + P1_athleticism + pn_np + Experience_high_low + pn_np * Experience_high_low

**Tests of Between-Subjects Effects**

Dependent Variable:P2_athleticism

| sbs_eos | Source | Type III Sum of Squares | df | Mean Square | F | Sig. | Partial Eta Squared | Noncent. Parameter | Observed Power[b] |
|---|---|---|---|---|---|---|---|---|---|
| EOS | Corrected Model | 2.594[a] | 4 | .649 | .448 | .774 | .023 | 1.792 | .150 |
| | Intercept | 27.918 | 1 | 27.918 | 19.282 | .000 | .205 | 19.282 | .991 |
| | P1_athleticism | 2.166 | 1 | 2.166 | 1.496 | .225 | .020 | 1.496 | .227 |
| | pn_np | .067 | 1 | .067 | .046 | .831 | .001 | .046 | .055 |
| | Experience_high_low | .288 | 1 | .288 | .199 | .657 | .003 | .199 | .072 |
| | pn_np * Experience_high_low | .221 | 1 | .221 | .153 | .697 | .002 | .153 | .067 |
| | Error | 108.593 | 75 | 1.448 | | | | | |
| | Total | 1869.000 | 80 | | | | | | |
| | Corrected Total | 111.187 | 79 | | | | | | |
| SBS | Corrected Model | 25.227[c] | 4 | 6.307 | 4.304 | .003 | .189 | 17.214 | .915 |
| | Intercept | 8.262 | 1 | 8.262 | 5.638 | .020 | .071 | 5.638 | .649 |
| | P1_athleticism | 12.605 | 1 | 12.605 | 8.601 | .004 | .104 | 8.601 | .825 |
| | pn_np | .292 | 1 | .292 | .199 | .657 | .003 | .199 | .073 |
| | Experience_high_low | .433 | 1 | .433 | .295 | .589 | .004 | .295 | .084 |
| | pn_np * Experience_high_low | 8.782 | 1 | 8.782 | 5.993 | .017 | .075 | 5.993 | .676 |
| | Error | 108.444 | 74 | 1.465 | | | | | |
| | Total | 1756.000 | 79 | | | | | | |
| | Corrected Total | 133.671 | 78 | | | | | | |

a. R Squared = .023 (Adjusted R Squared = -.029)

b. Computed using alpha = .05

c. R Squared = .189 (Adjusted R Squared = .145)

## Post hoc tests (Experience)

## COMBINED CONSTRUCT

**Group Statistics**

| sbs_eos | Ex_high_low | | pn_np | N | Mean | Std. Deviation | Std. Error Mean |
|---|---|---|---|---|---|---|---|
| SBS | 2.9_or_below | P2adjustedchange | pn | 20 | -2.0502 | 1.03299 | .23098 |
| | | | np | 21 | -1.2063 | 1.42391 | .31072 |
| | 3.0_or_above | P2adjustedchange | pn | 20 | -1.2332 | 1.30737 | .29234 |
| | | | np | 19 | -1.7961 | 1.20512 | .28405 |

**Independent Samples Test**

| sbs_eos | Ex_high_low | | | Levene's Test for Equality of Variances: F | Levene's Test for Equality of Variances: Sig. | t-test for Equality of Means: t | df | Sig. (2-tailed) | Mean Difference | Std. Error Difference | 95% Confidence Interval of the Difference: Lower | 95% Confidence Interval of the Difference: Upper |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SBS | Low_Ex | P2adjusted change | Equal variances assumed | .522 | .474 | -2.163 | 39 | .037 | -.84382 | .39019 | -1.6331 | -.05459 |
| | | | Equal variances not assumed | | | -2.179 | 36.48 | .036 | -.84382 | .38717 | -1.6287 | -.05896 |
| | High_Ex | P2adjusted change | Equal variances assumed | .566 | .457 | 1.375 | 37 | .178 | .56294 | .40940 | -.26737 | 1.3933 |
| | | | Equal variances not assumed | | | 1.381 | 36.97 | .176 | .56294 | .40761 | -.26375 | 1.3896 |

# Appendix 4

## Study 3: Assessment Instruments and SPSS Outputs

## Descriptive Statistics (Study 3)

**Statistics**

gender

| | | |
|---|---|---|
| N | Valid | 100 |
| | Missing | 0 |

**Gender**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | male | 74 | 74.0 | 74.0 | 74.0 |
| | female | 26 | 26.0 | 26.0 | 100.0 |
| | Total | 100 | 100.0 | 100.0 | |

**Descriptive Statistics**

| | N | Minimum | Maximum | Mean | Std. Deviation |
|---|---|---|---|---|---|
| age | 100 | 16.00 | 31.00 | 21.6563 | 2.43232 |
| Valid N (listwise) | 100 | | | | |

**Descriptive Statistics**

| | N | Minimum | Maximum | Mean | Std. Deviation |
|---|---|---|---|---|---|
| experience | 100 | .50 | 10.00 | 2.8568 | 2.00812 |
| Valid N (listwise) | 100 | | | | |

## Correlations between subscales (Study 3)

**Correlations**

| | | P1_ultimate_ability | P1_disc_control | P1_speed_of_thought |
|---|---|---|---|---|
| P1_ultimate_ability | Pearson Correlation | 1.000 | .643** | .302** |
| | Sig. (2-tailed) | | .000 | .003 |
| | N | 100 | 100 | 100 |
| P1_disc_control | Pearson Correlation | .643** | 1.000 | .226* |
| | Sig. (2-tailed) | .000 | | .027 |
| | N | 100 | 100 | 100 |
| P1_speed_of_thought | Pearson Correlation | .302** | .226* | 1.000 |
| | Sig. (2-tailed) | .003 | .027 | |
| | N | 100 | 100 | 100 |

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

**Correlations**

| | | P2_ultimate_ability | P2_disc_control | P2_speed_of_thought |
|---|---|---|---|---|
| P2_ultimate_ability | Pearson Correlation | 1.000 | .743** | .714** |
| | Sig. (2-tailed) | | .000 | .000 |
| | N | 100 | 100 | 100 |
| P2_disc_control | Pearson Correlation | .743** | 1.000 | .689** |
| | Sig. (2-tailed) | .000 | | .000 |
| | N | 100 | 100 | 100 |
| P2_speed_of_thought | Pearson Correlation | .714** | .689** | 1.000 |
| | Sig. (2-tailed) | .000 | .000 | |
| | N | 100 | 100 | 100 |

**. Correlation is significant at the 0.01 level (2-tailed).

## Order/accountability interaction (Study 3)

### ULTIMATE FRISBEE ABILITY

**Between-Subjects Factors**

| | | Value Label | N |
|---|---|---|---|
| pn_np | 1 | pn | 50 |
| | 2 | np | 50 |
| eos_int_acc | 1 | EOS | 50 |
| | 3 | accountability | 50 |

**Descriptive Statistics**

Dependent Variable:P2_ultimate_ability

| pn_np | eos_int_acc | Mean | Std. Deviation | N |
|---|---|---|---|---|
| pn | EOS | 5.7600 | 1.16476 | 25 |
| | accountability | 5.7391 | 1.28691 | 25 |
| | Total | 5.7500 | 1.21165 | 50 |
| np | EOS | 4.9130 | 1.08347 | 25 |
| | accountability | 5.1600 | 1.21381 | 25 |
| | Total | 5.0417 | 1.14777 | 50 |
| Total | EOS | 5.3542 | 1.19377 | 50 |
| | accountability | 5.4375 | 1.27005 | 50 |
| | Total | 5.3958 | 1.22671 | 100 |

**Levene's Test of Equality of Error Variances[a]**

Dependent Variable:P2_ultimate_ability

| F | df1 | df2 | Sig. |
|---|---|---|---|
| .070 | 3 | 96 | .976 |

Tests the null hypothesis that the error variance of the dependent variable is equal across groups.

a. Design: Intercept + P1_ultimate_ability + pn_np + eos_int_acc + pn_np * eos_int_acc

**Tests of Between-Subjects Effects**

Dependent Variable:P2_ultimate_ability

| Source | Type III Sum of Squares | df | Mean Square | F | Sig. | Partial Eta Squared | Noncent. Parameter | Observed Power[b] |
|---|---|---|---|---|---|---|---|---|
| Corrected Model | 20.286[a] | 4 | 5.072 | 3.762 | .007 | .142 | 15.049 | .874 |
| Intercept | 27.209 | 1 | 27.209 | 20.184 | .000 | .182 | 20.184 | .994 |
| P1_ultimate_ability | 7.509 | 1 | 7.509 | 5.570 | .020 | .058 | 5.570 | .646 |
| pn_np | 12.803 | 1 | 12.803 | 9.497 | .003 | .095 | 9.497 | .862 |
| eos_int_acc | .413 | 1 | .413 | .307 | .581 | .003 | .307 | .085 |
| pn_np * eos_int_acc | .161 | 1 | .161 | .119 | .731 | .001 | .119 | .063 |
| Error | 122.672 | 95 | 1.348 | | | | | |
| Total | 2938.000 | 100 | | | | | | |
| Corrected Total | 142.958 | 99 | | | | | | |

a. R Squared = .142 (Adjusted R Squared = .104)

b. Computed using alpha = .05

**DISC CONTROL**

**Between-Subjects Factors**

| | | Value Label | N |
|---|---|---|---|
| pn_np | 1 | pn | 50 |
| | 2 | np | 50 |
| eos_int_acc | 1 | EOS | 50 |
| | 3 | accountability | 50 |

**Descriptive Statistics**

Dependent Variable:P2_disc_control

| pn_np | eos_int_acc | Mean | Std. Deviation | N |
|---|---|---|---|---|
| pn | EOS | 5.7200 | 1.10000 | 25 |
| | accountability | 5.9565 | 1.49174 | 25 |
| | Total | 5.8333 | 1.29374 | 50 |
| np | EOS | 4.6087 | 1.11759 | 25 |
| | accountability | 4.9200 | 1.03763 | 25 |
| | Total | 4.7708 | 1.07663 | 50 |
| Total | EOS | 5.1875 | 1.23178 | 50 |
| | accountability | 5.4167 | 1.36574 | 50 |
| | Total | 5.3021 | 1.29874 | 100 |

**Levene's Test of Equality of Error Variances[a]**

Dependent Variable:P2_disc_control

| F | df1 | df2 | Sig. |
|---|---|---|---|
| .630 | 3 | 96 | .597 |

Tests the null hypothesis that the error variance of the dependent variable is equal across groups.

a. Design: Intercept + P1_disc_control + pn_np + eos_int_acc + pn_np * eos_int_acc

**Tests of Between-Subjects Effects**

Dependent Variable:P2_disc_control

| Source | Type III Sum of Squares | df | Mean Square | F | Sig. | Partial Eta Squared | Noncent. Parameter | Observed Power[b] |
|---|---|---|---|---|---|---|---|---|
| Corrected Model | 28.928[a] | 4 | 7.232 | 5.012 | .001 | .181 | 20.048 | .955 |
| Intercept | 67.036 | 1 | 67.036 | 46.456 | .000 | .338 | 46.456 | 1.000 |
| P1_disc_control | .004 | 1 | .004 | .002 | .961 | .000 | .002 | .050 |
| pn_np | 27.094 | 1 | 27.094 | 18.776 | .000 | .171 | 18.776 | .990 |
| eos_int_acc | 1.784 | 1 | 1.784 | 1.236 | .269 | .013 | 1.236 | .196 |
| pn_np * eos_int_acc | .034 | 1 | .034 | .024 | .878 | .000 | .024 | .053 |
| Error | 131.311 | 95 | 1.443 | | | | | |
| Total | 2859.000 | 100 | | | | | | |
| Corrected Total | 160.240 | 99 | | | | | | |

a. R Squared = .181 (Adjusted R Squared = .145)

b. Computed using alpha = .05

## SPEED OF THOUGHT

**Between-Subjects Factors**

| | | Value Label | N |
|---|---|---|---|
| pn_np | 1 | pn | 50 |
| | 2 | np | 50 |
| eos_int_acc | 1 | EOS | 50 |
| | 3 | accountability | 50 |

**Descriptive Statistics**

Dependent Variable:P2_speed_of_thought

| pn_np | eos_int_acc | Mean | Std. Deviation | N |
|---|---|---|---|---|
| pn | EOS | 5.8800 | 1.23558 | 25 |
| | accountability | 5.7391 | 1.42118 | 25 |
| | Total | 5.8125 | 1.31531 | 50 |
| np | EOS | 5.0000 | 1.38170 | 25 |
| | accountability | 5.4000 | 1.35401 | 25 |
| | Total | 5.2083 | 1.36769 | 50 |
| Total | EOS | 5.4583 | 1.36769 | 50 |
| | accountability | 5.5625 | 1.38235 | 50 |
| | Total | 5.5104 | 1.36879 | 100 |

**Levene's Test of Equality of Error Variances[a]**

Dependent Variable:P2_speed_of_thought

| F | df1 | df2 | Sig. |
|---|---|---|---|
| .691 | 3 | 96 | .560 |

Tests the null hypothesis that the error variance of the dependent variable is equal across groups.

a. Design: Intercept + P1_speed_of_thought + pn_np + eos_int_acc + pn_np * eos_int_acc

**Tests of Between-Subjects Effects**

Dependent Variable:P2_speed_of_thought

| Source | Type III Sum of Squares | df | Mean Square | F | Sig. | Partial Eta Squared | Noncent. Parameter | Observed Power[b] |
|---|---|---|---|---|---|---|---|---|
| Corrected Model | 11.284[a] | 4 | 2.821 | 1.540 | .197 | .063 | 6.159 | .459 |
| Intercept | 59.049 | 1 | 59.049 | 32.233 | .000 | .262 | 32.233 | 1.000 |
| P1_speed_of_thought | .369 | 1 | .369 | .201 | .655 | .002 | .201 | .073 |
| pn_np | 7.498 | 1 | 7.498 | 4.093 | .046 | .043 | 4.093 | .517 |
| eos_int_acc | .355 | 1 | .355 | .194 | .661 | .002 | .194 | .072 |
| pn_np * eos_int_acc | 1.636 | 1 | 1.636 | .893 | .347 | .010 | .893 | .155 |
| Error | 166.706 | 95 | 1.832 | | | | | |
| Total | 3093.000 | 100 | | | | | | |
| Corrected Total | 177.990 | 99 | | | | | | |

a. R Squared = .063 (Adjusted R Squared = .022)

b. Computed using alpha = .05

## Reliability statistics (accountability manipulation)

**Case Processing Summary**

| | | N | % |
|---|---|---|---|
| Cases | Valid | 100 | 100.0 |
| | Excluded[a] | 0 | .0 |
| | Total | 100 | 100.0 |

a. Listwise deletion based on all variables in the procedure.

**Reliability Statistics**

| Cronbach's Alpha | N of Items |
|---|---|
| .846 | 3 |

**Item Statistics**

| | Mean | Std. Deviation | N |
|---|---|---|---|
| Acc_1 | 8.3750 | 1.08821 | 100 |
| Acc_2 | 7.9167 | 1.31122 | 100 |
| Acc_3 | 8.4375 | 1.27165 | 100 |

**Item-Total Statistics**

| | Scale Mean if Item Deleted | Scale Variance if Item Deleted | Corrected Item-Total Correlation | Cronbach's Alpha if Item Deleted |
|---|---|---|---|---|
| Acc_1 | 16.3542 | 5.326 | .768 | .747 |
| Acc_2 | 16.8125 | 4.638 | .710 | .792 |
| Acc_3 | 16.2917 | 4.925 | .678 | .821 |

**Scale Statistics**

| Mean | Variance | Std. Deviation | N of Items |
|---|---|---|---|
| 24.7292 | 10.368 | 3.21994 | 3 |

**Did the accountability manipulation work?**

Group Statistics

| | eos_int_acc | N | Mean | Std. Deviation | Std. Error Mean |
|---|---|---|---|---|---|
| Acc_all3 | EOS | 50 | 8.1944 | 1.17265 | .16926 |
| | accountability | 50 | 8.2917 | .97395 | .14058 |

Independent Samples Test

| | | Levene's Test for Equality of Variances | | t-test for Equality of Means | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | 95% Confidence Interval of the Difference | |
| | | F | Sig. | t | df | Sig. (2-tailed) | Mean Difference | Std. Error Difference | Lower | Upper |
| Acc_all3 | Equal variances assumed | 3.312 | .072 | -.442 | 98 | .660 | -.09722 | .22002 | -.53408 | .33964 |
| | Equal variances not assumed | | | -.442 | 92.94 | .660 | -.09722 | .22002 | -.53427 | .33983 |

**Descriptive statistics of accountability (for median split)**

| | N | Minimum | Maximum | Mean | Std. Deviation |
|---|---|---|---|---|---|
| Acc_all3 | 100 | 5.33 | 10.00 | 8.2431 | 1.07331 |
| Valid N (listwise) | 100 | | | | |

Group Statistics

| | Acc_high_low | N | Mean | Std. Deviation | Std. Error Mean |
|---|---|---|---|---|---|
| Acc_all3 | below 8.2 | 37 | 7.1622 | .73544 | .12091 |
| | above 8.3 | 59 | 8.9209 | .58178 | .07574 |

**Independent Samples Test**

| | | Levene's Test for Equality of Variances | | t-test for Equality of Means | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | 95% Confidence Interval of the Difference | |
| | | F | Sig. | t | df | Sig. (2-tailed) | Mean Difference | Std. Error Difference | Lower | Upper |
| Acc_all3 | Equal variances assumed | 2.856 | .094 | -13.003 | 94 | .000 | -1.75874 | .13525 | -2.02729 | -1.49019 |
| | Equal variances not assumed | | | -12.327 | 63.709 | .000 | -1.75874 | .14267 | -2.04378 | -1.47370 |

## Order/motivation interaction

### ULTIMATE FRISBEE ABILITY

**Between-Subjects Factors**

| | | Value Label | N |
|---|---|---|---|
| pn_np | 1 | pn | 50 |
| | 2 | np | 50 |
| Acc_high_low | 1 | below 8.2 | 39 |
| | 2 | above 8.3 | 61 |

**Descriptive Statistics**

Dependent Variable:P2_ultimate_ability

| pn_np | Acc_high_low | Mean | Std. Deviation | N |
|---|---|---|---|---|
| pn | below 8.2 | 5.8261 | 1.23038 | 25 |
| | above 8.3 | 5.6800 | 1.21518 | 25 |
| | Total | 5.7500 | 1.21165 | 50 |
| np | below 8.2 | 4.8571 | 1.29241 | 15 |
| | above 8.3 | 5.1176 | 1.09447 | 35 |
| | Total | 5.0417 | 1.14777 | 50 |
| Total | below 8.2 | 5.4595 | 1.32486 | 39 |
| | above 8.3 | 5.3559 | 1.17095 | 61 |
| | Total | 5.3958 | 1.22671 | 100 |

**Levene's Test of Equality of Error Variances[a]**

Dependent Variable:P2_ultimate_ability

| F | df1 | df2 | Sig. |
|---|---|---|---|
| .261 | 3 | 96 | .853 |

Tests the null hypothesis that the error variance of the dependent variable is equal across groups.

a. Design: Intercept + P1_ultimate_ability + pn_np + Acc_high_low + pn_np * Acc_high_low

**Tests of Between-Subjects Effects**

Dependent Variable:P2_ultimate_ability

| Source | Type III Sum of Squares | df | Mean Square | F | Sig. | Partial Eta Squared | Noncent. Parameter | Observed Power[b] |
|---|---|---|---|---|---|---|---|---|
| Corrected Model | 21.096[a] | 4 | 5.274 | 3.938 | .005 | .148 | 15.753 | .890 |
| Intercept | 24.180 | 1 | 24.180 | 18.056 | .000 | .166 | 18.056 | .988 |
| P1_ultimate_ ability | 8.126 | 1 | 8.126 | 6.068 | .016 | .063 | 6.068 | .683 |
| pn_np | 12.593 | 1 | 12.593 | 9.404 | .003 | .094 | 9.404 | .859 |
| Acc_high_low | .179 | 1 | .179 | .134 | .715 | .001 | .134 | .065 |
| pn_np * Acc_high_low | 1.124 | 1 | 1.124 | .839 | .362 | .009 | .839 | .148 |
| Error | 121.862 | 95 | 1.339 | | | | | |
| Total | 2938.000 | 100 | | | | | | |
| Corrected Total | 142.958 | 99 | | | | | | |

a. R Squared = .148 (Adjusted R Squared = .110)

b. Computed using alpha = .05

## DISC CONTROL

**Between-Subjects Factors**

| | | Value Label | N |
|---|---|---|---|
| pn_np | 1 | pn | 50 |
| | 2 | np | 50 |
| Acc_high_low | 1 | below 8.2 | 39 |
| | 2 | above 8.3 | 61 |

**Descriptive Statistics**

Dependent Variable:P2_disc_control

| pn_np | Acc_high_low | Mean | Std. Deviation | N |
|---|---|---|---|---|
| pn | below 8.2 | 6.3043 | 1.18455 | 25 |
| | above 8.3 | 5.4000 | 1.25831 | 25 |
| | Total | 5.8333 | 1.29374 | 50 |
| np | below 8.2 | 4.9286 | .99725 | 15 |
| | above 8.3 | 4.7059 | 1.11544 | 35 |
| | Total | 4.7708 | 1.07663 | 50 |
| Total | below 8.2 | 5.7838 | 1.29390 | 39 |
| | above 8.3 | 5.0000 | 1.21769 | 61 |
| | Total | 5.3021 | 1.29874 | 100 |

**Levene's Test of Equality of Error Variances[a]**

Dependent Variable:P2_disc_control

| F | df1 | df2 | Sig. |
|---|---|---|---|
| .634 | 3 | 96 | .595 |

Tests the null hypothesis that the error variance of the dependent variable is equal across groups.

a. Design: Intercept + P1_disc_control + pn_np + Acc_high_low + pn_np * Acc_high_low

**Tests of Between-Subjects Effects**

Dependent Variable:P2_disc_control

| Source | Type III Sum of Squares | df | Mean Square | F | Sig. | Partial Eta Squared | Noncent. Parameter | Observed Power[b] |
|---|---|---|---|---|---|---|---|---|
| Corrected Model | 37.616[a] | 4 | 9.404 | 6.979 | .000 | .235 | 27.915 | .993 |
| Intercept | 56.345 | 1 | 56.345 | 41.814 | .000 | .315 | 41.814 | 1.000 |
| P1_disc_control | .233 | 1 | .233 | .173 | .679 | .002 | .173 | .070 |
| pn_np | 23.431 | 1 | 23.431 | 17.388 | .000 | .160 | 17.388 | .985 |
| Acc_high_low | 7.071 | 1 | 7.071 | 1.247 | .224 | .055 | 5.247 | .093 |
| pn_np * Acc_high_low | 2.377 | 1 | 2.377 | 1.764 | .187 | .019 | 1.764 | .260 |
| Error | 122.624 | 95 | 1.348 | | | | | |
| Total | 2859.000 | 100 | | | | | | |
| Corrected Total | 160.240 | 99 | | | | | | |

a. R Squared = .235 (Adjusted R Squared = .201)

b. Computed using alpha = .05

## SPEED OF THOUGHT

**Between-Subjects Factors**

| | | Value Label | N |
|---|---|---|---|
| pn_np | 1 | pn | 50 |
| | 2 | np | 50 |
| Acc_high_low | 1 | below 8.2 | 39 |
| | 2 | above 8.3 | 61 |

**Descriptive Statistics**

Dependent Variable:P2_speed_of_thought

| pn_np | Acc_high_low | Mean | Std. Deviation | N |
|---|---|---|---|---|
| pn | below 8.2 | 5.9565 | 1.10693 | 25 |
| | above 8.3 | 5.6800 | 1.49220 | 25 |
| | Total | 5.8125 | 1.31531 | 50 |
| np | below 8.2 | 5.1429 | 1.29241 | 15 |
| | above 8.3 | 5.2353 | 1.41547 | 35 |
| | Total | 5.2083 | 1.36769 | 50 |
| Total | below 8.2 | 5.6486 | 1.22964 | 39 |
| | above 8.3 | 5.4237 | 1.45274 | 61 |
| | Total | 5.5104 | 1.36879 | 100 |

**Levene's Test of Equality of Error Variances[a]**

Dependent Variable:P2_speed_of_thought

| F | df1 | df2 | Sig. |
|---|---|---|---|
| 2.002 | 3 | 96 | .119 |

Tests the null hypothesis that the error variance of the dependent variable is equal across groups.

a. Design: Intercept + P1_speed_of_thought + pn_np + Acc_high_low + pn_np * Acc_high_low

**Tests of Between-Subjects Effects**

Dependent Variable:P2_speed_of_thought

| Source | Type III Sum of Squares | df | Mean Square | F | Sig. | Partial Eta Squared | Noncent. Parameter | Observed Power[b] |
|---|---|---|---|---|---|---|---|---|
| Corrected Model | 10.429[a] | 4 | 2.607 | 1.416 | .235 | .059 | 5.664 | .425 |
| Intercept | 54.656 | 1 | 54.656 | 29.683 | .000 | .246 | 29.683 | 1.000 |
| P1_speed_of_thought | .667 | 1 | .667 | .362 | .549 | .004 | .362 | .092 |
| pn_np | 6.642 | 1 | 6.642 | 4.607 | .041 | .058 | 3.607 | .468 |
| Acc_high_low | .346 | 1 | .346 | .188 | .666 | .002 | .188 | .071 |
| pn_np * Acc_high_low | .674 | 1 | .674 | .366 | .547 | .004 | .366 | .092 |
| Error | 167.561 | 95 | 1.841 | | | | | |
| Total | 3093.000 | 100 | | | | | | |
| Corrected Total | 177.990 | 99 | | | | | | |

a. R Squared = .059 (Adjusted R Squared = .017)

b. Computed using alpha = .05

# Appendix 5

## Study 4: Assessment Instruments and SPSS Outputs

## Appendix 5.1

## End of Sequence assessment instrument (with interpolated task)

*Thank you for agreeing to take part in this study.*

Introduction and Rationale

In the current study we are interested in how people make judgments about the abilities of the individuals they observe when playing and coaching. In this experiment we will be asking you to observe an ultimate frisbee player perform a series of the same skill, which involves the player cutting towards the disc, making a catch, pivoting, and making a forehand pass to a team-mate on the run. You will then be asked to rate his performance and ability. There is no right or wrong answer, just your own impression that is important.

All information you provide will be treated in the strictest of confidence.

Name: ______________________________

Age: ____________

Ethnic Origin: __________________

Ultimate playing experience: _________ (years)

University of Chichester

**CONSENT FORM**

I, ...................................................... (PRINT NAME)
hereby give my consent to participate in the following test/activity **[investigating impressions of ability in sport]**

By signing this form I confirm that:

- the purpose of the test/activity has been explained to me;
- I am satisfied that I understand the procedures involved;
- the possible benefits and risks of the test/activity have been explained to me;
- any questions which I have asked about the test/activity have been answered to my satisfaction;
- I understand that, during the course of the test/activity, I have the right to ask further questions about it;
- the information which I have supplied to University of Chichester prior to taking part in the test/activity is true and accurate to the best of my knowledge and belief and I understand that I must notify promptly of any changes to the information;
- I understand that my personal information will not be released to any third parties without my permission;
- I understand that my participation in the test/activity is voluntary and I am therefore at liberty to withdraw my involvement at any stage;
- I understand that, if there is any concern about the appropriateness of my continuing in the test/activity, I may be asked to withdraw my involvement at any stage;
- I understand that once the test/activity has been completed, the information gained as a result of it will be used for the following purposes only: **[To explore the way people make impressions of the sporting ability of others].**

SIGNATURE OF THE SUBJECT ......................................

DATE ................................................

**Evaluation of Player 1**

On a scale of 1 (poor) to 10 (excellent), please rate the ultimate player for the following criteria. Please circle the number that you feel best rates the player.

Ultimate Ability (general)

| Poor | | | | | | | | | Excellent |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |

Disc control

| Poor | | | | | | | | | Excellent |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |

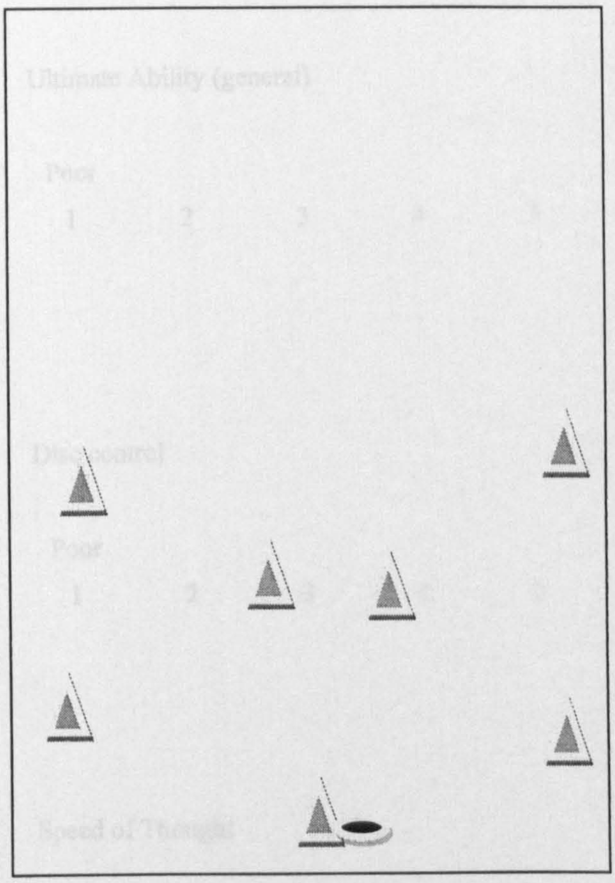
Speed of Thought

| Poor | | | | | | | | | Excellent |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |

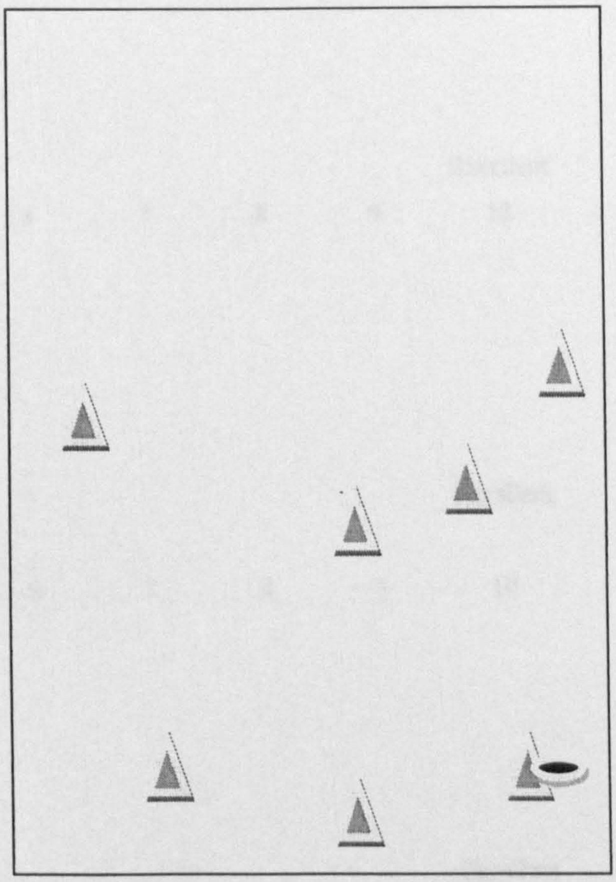
## Activity

Task 1 – there is a swirling wind and you want to play zone. The opposition is a decent side, with pretty good handling skills and quick wings that provide a credible deep threat.

Mark on the two diagrams the positions you would put your 7 defensive players.



Disc starts in middle of pitch.



Disc swung to the sideline.

Task 2

The players in the team playing zone are rather inexperienced? What specific/key advice/coaching hints would you offer to the defending team?

**Evaluation of Player 2**

On a scale of 1 (poor) to 10 (excellent), please rate the ultimate player for the following criteria. Please circle the number that you feel best rates the player.

Ultimate Ability (general)

| Poor | | | | | | | | | Excellent |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |

Disc control

| Poor | | | | | | | | | Excellent |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |

Speed of Thought

| Poor | | | | | | | | | Excellent |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |

**Appendix 5.2**

**SPSS Output for Study 4**

## Descriptive Statistics (Study 4)

**gender**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | male | 121 | 80.7 | 80.7 | 80.7 |
| | female | 29 | 19.3 | 19.3 | 100.0 |
| | Total | 150 | 100.0 | 100.0 | |

**Descriptive Statistics**

| | N | Minimum | Maximum | Mean | Std. Deviation |
|---|---|---|---|---|---|
| age | 150 | 16.00 | 31.00 | 21.4400 | 2.98200 |
| experience | 150 | .50 | 10.00 | 2.9217 | 2.09308 |
| Valid N (listwise) | 150 | | | | |

## Correlations between subscales (Study 4)

**Correlations**

| | | P1_ultimate_ability | P1_disc_control | P1_speed_of_thought |
|---|---|---|---|---|
| P1_ultimate_ability | Pearson Correlation | 1.000 | .582** | .480** |
| | Sig. (2-tailed) | | .000 | .000 |
| | N | 150 | 150 | 150 |
| P1_disc_control | Pearson Correlation | .582** | 1.000 | .357** |
| | Sig. (2-tailed) | .000 | | .000 |
| | N | 150 | 150 | 150 |
| P1_speed_of_thought | Pearson Correlation | .480** | .357** | 1.000 |
| | Sig. (2-tailed) | .000 | .000 | |
| | N | 150 | 150 | 150 |

**. Correlation is significant at the 0.01 level (2-tailed).

**Correlations**

| | | P2_ultimate_ability | P2_disc_control | P2_speed_of_thought |
|---|---|---|---|---|
| P2_ultimate_ability | Pearson Correlation | 1.000 | .792** | .755** |
| | Sig. (2-tailed) | | .000 | .000 |
| | N | 150 | 150 | 150 |
| P2_disc_control | Pearson Correlation | .792** | 1.000 | .688** |
| | Sig. (2-tailed) | .000 | | .000 |
| | N | 150 | 150 | 150 |
| P2_speed_of_thought | Pearson Correlation | .755** | .688** | 1.000 |
| | Sig. (2-tailed) | .000 | .000 | |
| | N | 150 | 150 | 150 |

**. Correlation is significant at the 0.01 level (2-tailed).

## Reliability statistics

**Case Processing Summary**

| | | N | % |
|---|---|---|---|
| Cases | Valid | 150 | 100.0 |
| | Excluded[a] | 0 | .0 |
| | Total | 150 | 100.0 |

a. Listwise deletion based on all variables in the procedure.

**Reliability Statistics**

| Cronbach's Alpha | N of Items |
|---|---|
| .896 | 3 |

**Item-Total Statistics**

| | Scale Mean if Item Deleted | Scale Variance if Item Deleted | Corrected Item-Total Correlation | Cronbach's Alpha if Item Deleted |
|---|---|---|---|---|
| P2_ultimate_ability | 10.9333 | 6.465 | .842 | .815 |
| P2_disc_control | 11.1267 | 6.326 | .788 | .859 |
| P2_speed_of_thought | 10.9000 | 6.386 | .761 | .883 |

## Order/judgment condition interactions (Study 4)

### ULTIMATE ABILITY

**Between-Subjects Factors**

| | | Value Label | N |
|---|---|---|---|
| pn_np | 1 | pn | 75 |
| | 2 | np | 75 |
| eos_int_delay | 1 | EOS | 50 |
| | 2 | interpolated | 50 |
| | 3 | interpolated_delay | 50 |

**Descriptive Statistics**

Dependent Variable:P2_ultimate_ability

| pn_np | eos_int_delay | Mean | Std. Deviation | N |
|---|---|---|---|---|
| pn | EOS | 5.7600 | 1.16476 | 25 |
| | interpolated | 4.9600 | 1.05987 | 25 |
| | interpolated_delay | 5.7600 | 1.36260 | 25 |
| | Total | 5.4933 | 1.24524 | 75 |
| np | EOS | 4.8800 | 1.05357 | 25 |
| | interpolated | 6.2000 | 1.35401 | 25 |
| | interpolated_delay | 5.7200 | 1.30767 | 25 |
| | Total | 5.6000 | 1.34566 | 75 |
| Total | EOS | 5.3200 | 1.18563 | 50 |
| | interpolated | 5.5800 | 1.35662 | 50 |
| | interpolated_delay | 5.7400 | 1.32187 | 50 |
| | Total | 5.5467 | 1.29318 | 150 |

**Levene's Test of Equality of Error Variances[a]**

Dependent Variable:P2_ultimate_ability

| F | df1 | df2 | Sig. |
|---|---|---|---|
| .649 | 5 | 144 | .663 |

Tests the null hypothesis that the error variance of the dependent variable is equal across groups.

**Tests of Between-Subjects Effects**

Dependent Variable:P2_ultimate_ability

| Source | Type III Sum of Squares | df | Mean Square | F | Sig. | Partial Eta Squared | Noncent. Parameter | Observed Power[b] |
|---|---|---|---|---|---|---|---|---|
| Corrected Model | 55.148[a] | 6 | 9.191 | 6.774 | .000 | .221 | 40.645 | .999 |
| Intercept | 25.773 | 1 | 25.773 | 18.995 | .000 | .117 | 18.995 | .991 |
| P1_ultimate_ability | 21.735 | 1 | 21.735 | 16.019 | .000 | .101 | 16.019 | .978 |
| pn_np | .665 | 1 | .665 | .490 | .485 | .003 | .490 | .107 |
| eos_int_delay | 3.536 | 2 | 1.768 | 1.303 | .275 | .018 | 2.606 | .279 |
| pn_np * eos_int_delay | 26.341 | 2 | 13.171 | 9.707 | .000 | .120 | 19.414 | .981 |
| Error | 194.025 | 143 | 1.357 | | | | | |
| Total | 4864.000 | 150 | | | | | | |
| Corrected Total | 249.173 | 149 | | | | | | |

a. R Squared = .221 (Adjusted R Squared = .189)

POST-HOC T-TESTS

**Group Statistics**

| eos_int_delay | | pn_np | N | Mean | Std. Deviation | Std. Error Mean |
|---|---|---|---|---|---|---|
| EOS | P2_adjusted_UA | pn | 25 | -.8800 | 1.53623 | .30725 |
| | | np | 25 | -1.6000 | 1.25831 | .25166 |
| interpolated | P2_adjusted_UA | pn | 25 | -1.6400 | .90738 | .18148 |
| | | np | 25 | -.4400 | 1.55671 | .31134 |
| interpolated_delay | P2_adjusted_UA | pn | 25 | -.9600 | 1.33791 | .26758 |
| | | np | 25 | -.9200 | 1.07703 | .21541 |

**Independent Samples Test**

| | | | Levene's Test for Equality of Variances | | t-test for Equality of Means | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | 95% Confidence Interval of the Difference | |
| eos_int_delay | | | F | Sig. | t | df | Sig. (2-tailed) | Mean Difference | Std. Error Difference | Lower | Upper |
| EOS | P2_adjusted_UA | Equal variances assumed | .435 | .513 | 2.113 | 48 | .046 | .72000 | .39716 | -.07854 | 1.51854 |
| | | Equal variances not assumed | | | 2.113 | 46.208 | .046 | .72000 | .39716 | -.07934 | 1.51934 |
| interpolated | P2_adjusted_UA | Equal variances assumed | 6.327 | .015 | -3.330 | 48 | .002 | -1.20000 | .36037 | -1.92457 | -.47543 |
| | | Equal variances not assumed | | | -3.330 | 38.620 | .002 | -1.20000 | .36037 | -1.92915 | -.47085 |
| interpolated_delay | P2_adjusted_UA | Equal variances assumed | .741 | .394 | -.116 | 48 | .908 | -.04000 | .34351 | -.73068 | .65068 |
| | | Equal variances not assumed | | | -.116 | 45.906 | .908 | -.04000 | .34351 | -.73149 | .65149 |

## DISC CONTROL

**Between-Subjects Factors**

| | | Value Label | N |
|---|---|---|---|
| pn_np | 1 | pn | 75 |
| | 2 | np | 75 |
| eos_int_delay | 1 | EOS | 50 |
| | 2 | interpolated | 50 |
| | 3 | interpolated_delay | 50 |

**Descriptive Statistics**

Dependent Variable:P2_disc_control

| pn_np | eos_int_delay | Mean | Std. Deviation | N |
|---|---|---|---|---|
| pn | EOS | 5.7200 | 1.10000 | 25 |
| | interpolated | 4.7200 | 1.20830 | 25 |
| | interpolated_delay | 5.5600 | 1.26095 | 25 |
| | Total | 5.3333 | 1.25562 | 75 |
| np | EOS | 4.6800 | 1.10755 | 25 |
| | interpolated | 6.0800 | 1.49778 | 25 |
| | interpolated_delay | 5.3600 | 1.55134 | 25 |
| | Total | 5.3733 | 1.49570 | 75 |
| Total | EOS | 5.2000 | 1.21218 | 50 |
| | interpolated | 5.4000 | 1.51186 | 50 |
| | interpolated_delay | 5.4600 | 1.40277 | 50 |
| | Total | 5.3533 | 1.37639 | 150 |

**Levene's Test of Equality of Error Variances[a]**

Dependent Variable:P2_disc_control

| F | df1 | df2 | Sig. |
|---|---|---|---|
| 1.089 | 5 | 144 | .369 |

Tests the null hypothesis that the error variance of the dependent variable is equal across groups.

a. Design: Intercept + P1_disc_control + pn_np + eos_int_delay + pn_np * eos_int_delay

**Tests of Between-Subjects Effects**

Dependent Variable:P2_disc_control

| Source | Type III Sum of Squares | df | Mean Square | F | Sig. | Partial Eta Squared | Noncent. Parameter | Observed Power[b] |
|---|---|---|---|---|---|---|---|---|
| Corrected Model | 47.756[a] | 6 | 7.959 | 4.853 | .000 | .169 | 29.120 | .990 |
| Intercept | 57.981 | 1 | 57.981 | 35.354 | .000 | .198 | 35.354 | 1.000 |
| P1_disc_control | 8.762 | 1 | 8.762 | 5.343 | .022 | .036 | 5.343 | .632 |
| pn_np | .090 | 1 | .090 | .055 | .815 | .000 | .055 | .056 |
| eos_int_delay | 2.646 | 2 | 1.323 | .807 | .448 | .011 | 1.614 | .186 |
| pn_np * eos_int_delay | 38.368 | 2 | 19.184 | 11.698 | .000 | .141 | 23.395 | .994 |
| Error | 234.518 | 143 | 1.640 | | | | | |
| Total | 4581.000 | 150 | | | | | | |
| Corrected Total | 282.273 | 149 | | | | | | |

a. R Squared = .169 (Adjusted R Squared = .134)

POST-HOC T-TESTS

**Group Statistics**

| eos_int_delay | | pn_np | N | Mean | Std. Deviation | Std. Error Mean |
|---|---|---|---|---|---|---|
| EOS | P2_adjusted_DC | pn | 25 | -.9200 | 1.65630 | .33126 |
| | | np | 25 | -2.1200 | 1.61555 | .32311 |
| interpolated | P2_adjusted_DC | pn | 25 | -1.8400 | 1.31276 | .26255 |
| | | np | 25 | -.4000 | 1.32288 | .26458 |
| interpolated_delay | P2_adjusted_DC | pn | 25 | -1.0400 | 1.67033 | .33407 |
| | | np | 25 | -1.0400 | 1.56738 | .31348 |

**Independent Samples Test**

| | | | Levene's Test for Equality of Variances | | t-test for Equality of Means | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | 95% Confidence Interval of the Difference | |
| eos_int_delay | | | F | Sig. | t | df | Sig. (2-tailed) | Mean Difference | Std. Error Difference | Lower | Upper |
| EOS | P2_adjusted_DC | Equal variances assumed | .010 | .921 | 2.593 | 48 | .013 | 1.20000 | .46275 | .26959 | 2.13041 |
| | | Equal variances not assumed | | | 2.593 | 47.970 | .013 | 1.20000 | .46275 | .26957 | 2.13043 |
| interpolated | P2_adjusted_DC | Equal variances assumed | .000 | .988 | -3.863 | 48 | .000 | -1.44000 | .37274 | -2.18944 | -.69056 |
| | | Equal variances not assumed | | | -3.863 | 47.997 | .000 | -1.44000 | .37274 | -2.18944 | -.69056 |
| interpolated_delay | P2_adjusted_DC | Equal variances assumed | .069 | .794 | .000 | 48 | 1.000 | .00000 | .45811 | -.92110 | .92110 |
| | | Equal variances not assumed | | | .000 | 47.807 | 1.000 | .00000 | .45811 | -.92119 | .92119 |

## SPEED OF THOUGHT

**Between-Subjects Factors**

| | | Value Label | N |
|---|---|---|---|
| pn_np | 1 | pn | 75 |
| | 2 | np | 75 |
| eos_int_delay | 1 | EOS | 50 |
| | 2 | interpolated | 50 |
| | 3 | interpolated_delay | 50 |

**Descriptive Statistics**

Dependent Variable:P2_speed_of_thought

| pn_np | eos_int_delay | Mean | Std. Deviation | N |
|---|---|---|---|---|
| pn | EOS | 5.8800 | 1.23558 | 25 |
| | interpolated | 5.2400 | 1.30000 | 25 |
| | interpolated_delay | 5.7200 | 1.51438 | 25 |
| | Total | 5.6133 | 1.36454 | 75 |
| np | EOS | 5.0000 | 1.32288 | 25 |
| | interpolated | 5.9600 | 1.54056 | 25 |
| | interpolated_delay | 5.6800 | 1.28193 | 25 |
| | Total | 5.5467 | 1.42652 | 75 |
| Total | EOS | 5.4400 | 1.34255 | 50 |
| | interpolated | 5.6000 | 1.45686 | 50 |
| | interpolated_delay | 5.7000 | 1.38873 | 50 |
| | Total | 5.5800 | 1.39159 | 150 |

**Levene's Test of Equality of Error Variances[a]**

Dependent Variable:P2_speed_of_thought

| F | df1 | df2 | Sig. |
|---|---|---|---|
| .871 | 5 | 144 | .502 |

Tests the null hypothesis that the error variance of the dependent variable is equal across groups.

a. Design: Intercept + P1_speed_of_thought + pn_np + eos_int_delay + pn_np * eos_int_delay

**Tests of Between-Subjects Effects**

Dependent Variable:P2_speed_of_thought

| Source | Type III Sum of Squares | df | Mean Square | F | Sig. | Partial Eta Squared | Noncent. Parameter | Observed Power[b] |
|---|---|---|---|---|---|---|---|---|
| Corrected Model | 19.904[a] | 6 | 3.317 | 1.766 | .110 | .069 | 10.595 | .651 |
| Intercept | 109.134 | 1 | 109.134 | 58.094 | .000 | .289 | 58.094 | 1.000 |
| P1_speed_of_thought | 2.004 | 1 | 2.004 | 1.067 | .303 | .007 | 1.067 | .177 |
| pn_np | .057 | 1 | .057 | .030 | .862 | .000 | .030 | .053 |
| eos_int_delay | 1.973 | 2 | .987 | .525 | .593 | .007 | 1.050 | .135 |
| pn_np * eos_int_delay | 15.308 | 2 | 7.654 | 4.074 | .019 | .054 | 8.148 | .716 |
| Error | 268.636 | 143 | 1.879 | | | | | |
| Total | 4959.000 | 150 | | | | | | |
| Corrected Total | 288.540 | 149 | | | | | | |

a. R Squared = .069 (Adjusted R Squared = .030)

b. Computed using alpha = .05

POST HOC T-TESTS

**Group Statistics**

| eos_int_delay | | pn_np | N | Mean | Std. Deviation | Std. Error Mean |
|---|---|---|---|---|---|---|
| EOS | P2_adjusted_SoT | pn | 25 | -.9600 | 1.39881 | .27976 |
| | | np | 25 | -1.2000 | 1.93649 | .38730 |
| interpolated | P2_adjusted_SoT | pn | 25 | -1.2000 | 1.58114 | .31623 |
| | | np | 25 | -.1600 | 1.77200 | .35440 |
| interpolated_delay | P2_adjusted_SoT | pn | 25 | -.5600 | 1.89473 | .37895 |
| | | np | 25 | -.7600 | 1.61452 | .32290 |

**Independent Samples Test**

| | | | Levene's Test for Equality of Variances | | t-test for Equality of Means | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | 95% Confidence Interval of the Difference | |
| eos_int_delay | | | F | Sig. | t | df | Sig. (2-tailed) | Mean Difference | Std. Error Difference | Lower | Upper |
| EOS | P2_adjusted_SoT | Equal variances assumed | 3.616 | .063 | .502 | 48 | .618 | .24000 | .47777 | -.72063 | 1.20063 |
| | | Equal variances not assumed | | | .502 | 43.686 | .618 | .24000 | .47777 | -.72308 | 1.20308 |
| interpolated | P2_adjusted_SoT | Equal variances assumed | .129 | .721 | -2.190 | 48 | .033 | -1.04000 | .47497 | -1.99500 | -.08500 |
| | | Equal variances not assumed | | | -2.190 | 47.390 | .034 | -1.04000 | .47497 | -1.99532 | -.08468 |
| interpolated_delay | P2_adjusted_SoT | Equal variances assumed | .953 | .334 | .402 | 48 | .690 | .20000 | .49786 | -.80102 | 1.20102 |
| | | Equal variances not assumed | | | .402 | 46.821 | .690 | .20000 | .49786 | -.80167 | 1.20167 |

# Appendix 6

## Hogarth and Einhorn's (1992) belief adjustment model: Mathematical calculations.

## HOGARTH AND EINHORN'S (1992) BELIEF-ADJUSTMENT MODEL: MATHEMATICAL CALCULATIONS

If we attach a value to the eight pieces of evidence used in the present study, we can examine the potential reasons for primacy effects from a mathematical perspective, when referring back to the algebraic equations presented by Hogarth and Einhorn (1992).

For EoS judgments, the anchoring and adjustment can be written in algebraic terms as

$$S_k = S(x_1) + w_k[s(x_2 + x_{3,} + \ldots\ldots x_k / x_n) - R] \qquad (1)$$

$S_k$ = The overall judgment (after evaluating k pieces of evidence)

$s(x_k)$ = an individual's subjective evaluation of a certain piece (*k*th piece) of evidence (e.g. $S(x_1)$ is the evaluation of the first piece of evidence

$w_k$ = the adjustment weight of a piece/pieces of evidence.

$s(x_2 + x_{3,} + \ldots\ldots x_k / x_n)$ = the averaged aggregate of evidence following the anchor.

$R$ = The reference point against which the impact of evidence is evaluated.

We can say that evidence has a weighting of between 0 (no weighting) and 1 (maximum weighting).

We can also insert the values of the evidence between 1 (weakest performance) to 10 (strongest performance). In the present thesis, we had 3 examples of 'good' performance ($x_1 = 8, x_2 = 8$, $x_3 = 8$), 2 examples of moderate performance ($x_4 = 5, x_5 = 5$), and 3 examples of poor performance ($x_6 = 8, x_7 = 8$, $x_8 = 8$).

Hogarth and Einhorn propose that when there is no prior information, the first piece of evidence ($S(x_1)$) becomes the anchor. Following this, the remaining evidence $(s(x_2 + x_{3,} + \ldots\ldots x_k/x_n))$ is some weighted average, of the individual evaluations of items of evidence that follow the anchor.

This theorising can explain why primacy effects occur. If participants give a medium weighting (0.5) to the evidence following the anchor, then mathematically for the declining order of clips ($x_1 - x_8$), the overall judgment would be;

$$= S(x_1) + w_k[s(x_2 + x_{3,} + \ldots\ldots x_k / x_n) - R]$$

$= 8 + 0.5[(8+8+5+5+2+2+2)/7 - 8]$

$= 6.29.$ (2)

Alternatively, for the ascending order of clips ($x_8 - x_1$), the overall judgment would be;

$= 2 + 0.5[(2+2+5+5+8+8+8)/7 - 2]$

$= 3.71$ (3)

Thus, the final numerical judgment is higher when viewing the declining order of clips, compared to the ascending order, which highlights the primacy effect.

The present thesis aimed to test the predictions and theorising of Hogarth and Einhorn's (1992) model. Several findings failed to support the hypotheses drawn from Hogarth and Einhorn's model, and thus raised some important questions. For example;
Why did primacy effects emerge in the incomplete method of SbS processing?

*Why did primacy effects emerge in the incomplete method of SbS processing?*

Why did no order effects emerge in the SbS condition, when the model predicts recency?
SbS processing would be expected to create recency effects, if equal weighting was given to each piece of evidence. Hogarth and Einhorn explain how SbS processing results in later information having greater weighting. An SbS processing strategy can be written in algebraic terms as

$$S_k = S_{k-1} + w_k[s(x_k) - R] \quad (4)$$

With $S_{k-1}$ representing the anchor and then being adjusted as many times as there are pieces of evidence, and where $w_k$ represents the adjustment weight of a piece (the *k*th piece) of evidence. If each piece of evidence is given a medium weighting (0.5), then mathematically for the declining order of clips ($x_1 - x_8$), the overall judgment would be;
$= 8 + [0.5(8-8)] + [0.5(8-8)] + [0.5(5-8)] + [0.5(5-6.5)] + [0.5(2-5.75)] + [0.5(2-3.88)] + [0.5(2-2.94)]$

= 8 + 0 + 0 + -1.5 + -0.75 + -1.88 + -0.94 + -0.47

= 2.47 (5)

Alternatively, for the ascending order of clips ($x_8 - x_1$), the overall judgment would be;
= 2 + [0.5(2-2)] + [0.5(2-2)] + [0.5(5-2)] + [0.5(5-3.5)] + [0.5(8-4.25)] + [0.5(8-6.13)] + [0.5(8-7.06)]

= 2 + 0 + 0 + 1.5 + 0.75 + 1.875 + 0.93 + 0.47

= 7.53 (6)

The results of these equations indicate recency effects are expected in the SbS condition as the overall judgment is higher viewing the ascending order compared to viewing the declining order.

However, in the SbS condition that replicated the SbS processing that was used in Greenlees et al.'s (2007) study, primacy effects still emerged in the present thesis. With a weak method of SbS processing, the adjustment weight ($w_k$) was reduced, meaning later evidence had less weighting on the overall judgment. Thus, the later evidence was not strong enough to offset the influence of the initial anchor, and consequently this SbS processing failed to eliminate primacy effects.

*Primacy Effects in the incomplete SbS condition*

If each piece of evidence is given a reduced weighting (e.g. a value of 0.1), then mathematically for the declining order of clips ($x_1 - x_8$), the overall judgment would be;
= 8 + [0.1(8-8)] + [0.1(8-8)] + [0.1(5-8)] + [0.1(5-7.7)] + [0.1(2-7.43)] + [0.1(2-6.89)] + [0.1(2-6.40)]

= 8 + 0 + 0 + -0.3 + -0.27 + -0.54 + -0.66 + -0.56 + -0.44

= 5.96 (7)

Alternatively, for the ascending order of clips ($x_8 - x_1$), the overall judgment would be;
= 2 + [0.1(2-2)] + [0.1(2-2)] + [0.1(5-2)] + [0.1(5-2.3)] + [0.1(8-2.57)] + [0.1(8-3.11)] + [0.1(8-3.60)]

= 2 + 0 + 0 + 0.3 + 0.27 + 0.54 + 0.49 + 0.44

= 4.04 (8)

The numerical rating from these calculations using a weak weighting of later information demonstrates a primacy effect, with the rating in the declining order higher (5.96) compared to the ascending condition (4.04).

*No order effects in the extended SbS condition*

In the extended SbS condition, no order effects were displayed. This more thorough SbS processing would result in greater weighting of later evidence compared to the more incomplete SbS measure, described above. However, if the weighting of the later evidence is of a certain level relative to the initial anchor, this weighting might only be strong enough to offset the influence of the initial anchor, and not produce recency effects. For example, if the weighting given to later information was reduced (e.g. to a value of 0.16), the following mathematical calculations could be made.

For the declining order of clips ($x_1 - x_8$);

= 8 + [0.16(8-8)] + [0.16(8-8)] + [0.16(5-8)] + [0.16(5-7.52)] + [0.16(2-7.12)] + [0.16(2-6.30)] + [0.16(2-5.61)]

= 8 + 0 + 0 + -0.48 + -0.40 + -0.82 + -0.69 + -0.58

= 5.03 (9)

Alternatively, for the ascending order of clips ($x_8 - x_1$);

= 2 + [0.16(2-2)] + [0.16(2-2)] + [0.16(5-2)] + [0.16(5-2.48)] + [0.16(8-2.88)] + [0.16(8-3.70)] + [0.16(8-4.16)]

= 2 + 0 + 0 + 0.48 + 0.40 + 0.82 + 0.69 + 0.58

= 4.97 (10)

*Participants with high motivation to think/high accountability/low experience showing primacy (in EoS condition)*

It was hypothesised in Study 3 that participants with high motivation to think, high accountability, and low experience would show no order effects in the EoS condition, as they would more effortfully process information in a SbS manner. However, in each of these conditions, primacy effects were displayed in the EoS condition. One explanation is that some SbS processing was used but the processing of later information involved a very weak weighting compared to the weighting of the anchor. Referring to the calculations in the SbS condition (above), if the weighting of later information was reduced further, then that would result in primacy effects even if SbS processing was used. Thus, even when SbS processing is used, such an algebraic equation, with reduced weighting of later evidence, could be written as;

$$= S(x_1) + 0.5[s(x_2) - R] + 0.5[s(x_3) - R] + 0.3[s(x_4) - R] + 0.2[s(x_5) - R] + 0.1[s(x_6) - R] + 0.1[s(x_7) - R] + 0.1[s(x_8) - R] \quad (11)$$

For the declining order of clips ($x_1 - x_8$), such a weighting of later evidence would produce the overall judgment;

= 8 + [0.5(8-8)] + [0.5(8-8)] + [0.2(5-8)] + [0.2(5-7.4)] + [0.1(2-6.92)] + [0.1(2-6.47)] + [0.1(2-6.02)]

= 8 + 0 + 0 + -0.6 + -.0.49 + -0.44 + -0.45 + -0.40

= 5.62 (12)

And for the ascending order of clips ($x_8 - x_1$);

= 2 + [0.5(2-2)] + [0.5(2-2)] + [0.2(5-8)] + [0.2(5-2.6)] + [0.1(8-3.08)] + [0.1(8-3.57)] + [0.1(8-4.01)]

= 2 + 0 + 0 + 0.6 + 0.48 + 0.49 + 0.44 + 0.40

= 4.41 (13)

Again, a crude set of ratings were used, but such a reduction of weighting of later evidence would explain why reduced weighting of later evidence produced primacy effects with ratings higher in the declining order (5.62) compared to the ascending order (4.41)

*Participants in the interpolated condition showed recency, while participants in the delay condition showed no order effects.*

When the interpolated activity/delay were in place, the equation could be adjusted to;

$S_k = w_k[s(x_1 + x_2 + x_3 + x_4)/4 - R] + w_k[s(x_5 + x_6 + x_7 + x_8)/4 - R]\}$

It appears that the delay condition allowed participants opportunity to assess the early series of information (i.e. clips 1-4), and thus, it is likely that the weighting of the early series of information was similar in weight to the later series of information.

So for the declining order;

$$\begin{aligned} S_k &= w_k[s(x_1 + x_2 + x_3 + x_4)/4 - R] + w_k[s(x_5 + x_6 + x_7 + x_8)/4 - R]\} \\ &= 0.5[(8 + 8 + 8 + 5)/4] + 0.5[(5 + 2 + 2 + 2)/4] \\ &= 3.625 + 1.375 \\ &= 5 \qquad (14) \end{aligned}$$

And for the ascending condition;

$$\begin{aligned} S_k &= w_k[s(x_1 + x_2 + x_3 + x_4)/4 - R] + w_k[s(x_5 + x_6 + x_7 + x_8)/4 - R]\} \\ &= 0.5[(5 + 2 + 2 + 2)/4] + 0.5[(8 + 8 + 8 + 5)/4] \\ &= 1.375 + 3.625 \\ &= 5 \qquad (15) \end{aligned}$$

Thus, equal weighting of the first and second series of information in the delay condition, results in the same rating for the declining and ascending order, and therefore, no order effects.

The interpolated condition caused cognitive resources to be taken away from processing the initial information. Consequently, and in comparison to the delay condition, the later series has more weighting on the overall impression compared to the early information.

So for the declining order;

$$
\begin{aligned}
S_k &= w_k[s(x_1 + x_2 + x_3 + x_4)/4 - R] + w_k[s(x_5 + x_6 + x_7 + x_8)/4 - R]\} \\
&= 0.3[(8 + 8 + 8 + 5)/4] + 0.7[(5 + 2 + 2 + 2)/4] \\
&= 2.175 + 1.925 \\
&= 4.1 \qquad (16)
\end{aligned}
$$

And for the ascending condition;

$$
\begin{aligned}
S_k &= w_k[s(x_1 + x_2 + x_3 + x_4)/4 - R] + w_k[s(x_5 + x_6 + x_7 + x_8)/4 - R]\} \\
&= 0.3[(5 + 2 + 2 + 2)/4] + 0.7[(8 + 8 + 8 + 5)/4] \\
&= 0.825 + 5.075 \\
&= 5.9 \qquad (17)
\end{aligned}
$$

Thus, the interpolated condition produces a recency effect with the declining order (4.1) rated lower than the ascending order (5.9).

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