Explaining Effects of Event Valence on Unrealistic Optimism

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Ethics Summary Statement

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We the undersigned declare that the above-named research project has been completed as described in the Application for Ethics Approval and in accordance with the ethics guidelines of Deakin University.

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Literature Review

Abstract

People typically display ‘unrealistic optimism’ (UO) regarding future events: they believe they are more likely to experience positive events, and less likely to experience negative events, than the average person like themselves. Several early studies found that UO is typically stronger for negative events than positive events. A recent study sought to test this relationship experimentally by framing a single event in either a positive or negative light; it was found that framing an event negatively led to greater UO than framing the same event positively. The authors of this study sought to explain this valence effect in terms of motivational processes. However, an alternative, cognitive theory also exists, involving group size effects resulting from use of the ‘numerosity heuristic’. This review details both explanations and evaluates them in light of the evidence to date. It is argued that evidence for the numerosity explanation may not generalise to the standard UO paradigm. A study to test between the two explanations is proposed; implications for understanding UO and for health promotion are also discussed.

The term ‘unrealistic optimism’ (UO) refers to an anomaly apparent in individuals’ expectations about the future: people typically believe they are more likely to experience positive events, and less likely to experience negative events, than the average person like themselves (Weinstein, 1980). Although this may be true for any one individual, it is generally unrealistic for a majority to hold this belief. Logically, unless the objective distribution of probability is heavily skewed, a majority cannot have better-than-average chances. Therefore, UO represents a bias in judgement, evident whenever a group, as a whole, rates its chances as better than average.

UO occurs for a broad range of events, including the prospect of being murdered (Weinstein, 1986), contracting breast cancer (Absetz, Aro, Rehnberg & Sutton, 2000), owning one’s own home (Weinstein, 1980), or finding a job on the internet (Campbell, Greenauer, Macaluso & End, 2007). Furthermore, it is evident across gender, age, and other demographic variables (Weinstein, 1987). The importance of the phenomenon lies in the possibility that it may influence behaviour (McKenna, 1993; Weinstein, 1987). In particular, health psychologists have expressed interest in the possibility that UO may make individuals more likely to engage in health risk behaviours, or less likely to take steps to prevent health risks (e.g., Absetz, 2000; Gold & Aucote, 2003; Wendt, 2005). Although conclusive evidence has yet to be found for such a causal relationship (van der Plight, 1998), this possibility has led to numerous studies into UO.

Much of this research has concerned the question of what causes UO. To shed light on this question, many studies have sought to identify and explain the influence of variables that affect UO. This review is related to that body of research, with a specific focus on one particular phenomenon: the finding that negative events typically elicit greater UO than positive events.

Measures of UO

There are two methods for assessing UO: directly and indirectly. In the direct method, a single question is employed: the participant is asked to rate his/her chances of experiencing an event relative to the average person like him/herself (i.e., relative to the average member of a comparison group to which the participant belongs). For example, a sample of students may be asked, “Compared with the average student at your university what is the chance that you will experience event X?”

The indirect method uses a pair of questions: one question asks the participant to rate his/her own likelihood (a self-estimate), the other asks the participant to rate the likelihood of the average person (an other-estimate). For example, participants may be asked both, “What is your chance of experiencing event X?” and “What is the chance that the average student at your university will experience event X?” UO is calculated as the difference between these two estimates.

It has been shown that direct and indirect measures of UO are not entirely equivalent (Heine & Lehman, 1995; Klein & Helweg-Larsen, 2002; Price, Pentecost, & Voth, 2002). In particular, when participants answer the single question used in the direct method, they do not appear to give much consideration to the probability of the average person (Aucote & Gold, 2005; Eiser, Pahl & Prins, 2001; Klar & Giladi, 1997). Therefore, UO measured directly mainly reflects participants’ judgements of self-risk, whereas UO measured indirectly reflects both self- and other-risk equally.

The Motivational and Cognitive Accounts of UO

Two models have been proposed to explain why UO occurs. One is motivational in nature; the other is cognitive.

The motivational account holds that people adopt optimistic beliefs about the future to bring themselves comfort. Specifically, UO may arise from a need to reduce anxiety (Kirscht, Haefner, Kegeles, & Rosenstock, 1966; Weinstein, 1980) or to protect self-esteem (Perloff, 1983; Weinstein, 1982). One way this might occur is via ‘motivated reasoning’, a process in which an individual selectively employs reasoning strategies in order to arrive at a desired conclusion (Kunda, 1987, 1990). By this means, individuals may emphasise to themselves certain factors, and downplay others, to support optimistic estimates. Alternatively, individuals may by-pass reasoning altogether and adopt an optimistic conclusion directly (Chen, Duckworth & Chaiken, 1999). For example, if an individual has arrived at an optimistic conclusion in the past, he/she may merely adopt the same conclusion without giving the issue much further consideration, and in doing so avoid information that may threaten his/her optimism (Chen et al., 1999).

In contrast, the cognitive account holds that UO serves no particular purpose for the individual. Rather, UO is proposed to occur as a side effect of one or more normal cognitive processes. For example, Weinstein (1980) proposed that UO could be a by-product of the availability heuristic — a cognitive strategy whereby individuals infer event frequency/probability from the ease with which examples of the event come to mind (Tversky & Kahneman, 1973). He pointed out that one’s own goal-directed behaviours (i.e., behaviors that facilitate positive events, or prevent negative ones) are likely to be more salient in memory than instances of the same behaviours performed by others. This is because of the personal effort typically involved in the execution of these behaviours (e.g., the effort involved in exercising to avoid health problems, or studying to achieve good grades). In using the availability heuristic, individuals may therefore tend to conclude that they perform these behaviours more often than others, and on this basis draw optimistic conclusions. This is one mechanism that could produce UO despite an individual's genuine attempt to accurately evaluate his/her chances.

In order to try to distinguish between the motivational and cognitive accounts, previous research has sought to identify variables that moderate UO. Several have been found. For example, the perceived controllability of events (Klein & Helweg-Larsen, 2002; Taylor & Gollwitzer, 1995; Weinstein, 1980, 1982), the perceived probability of events (Chambers, Windschitl & Suls, 2003), and the belief that an event is preceded by warning signs (Weinstein, 1982, 1987) have all been shown to moderate UO. However, distinguishing between the two explanations on the basis of these findings has proven difficult because the influence of many of these variables can be interpreted in terms of both the motivational and cognitive accounts. For example, the moderating effect of perceived controllability can be explained motivationally: failing to manage a controllable event might imply that one lacks competence or discipline, and this threat to self-esteem may therefore elicit greater motivation for UO (Weinstein, 1980, 1982). However, a plausible cognitive alternative is that controllable events elicit greater UO merely because participants can easily bring to mind actions that they can take to prevent or facilitate these events, but they fail to realise that these actions are also available to others (Weinstein 1980).

The remainder of this review concerns a similar problem. Alternative motivational and cognitive explanations have been proposed for yet another event characteristic shown to moderate UO — event valence.

The Effect of Event Valence on UO

'Event valence' refers to whether an event is generally considered positive (e.g., winning the lottery) or negative (e.g., having a car accident). Although UO has been found for events of either valence, in several early studies, negative events elicited greater UO than positive events (Eiser, Pahl, & Prins, 2001; Hoorens, 1995; Weinstein, 1980; Zakay, 1996). However, whether this trend was specifically due to valence was unclear. The positive and negative events used in these studies were not matched on all characteristics other than valence. As such, valence was potentially confounded with other event characteristics (Gold & Martyn, 2003).

To clarify this issue, Gold and Martyn (2003, 2004) conducted two studies that manipulated event valence by framing a single event either positively or negatively. Participants in these studies received questionnaires concerning a little-known yet significant health concern (e.g., the effects of the amino acid homocysteine on the chance of experiencing heart problems in later life). An unfamiliar risk was chosen so that participants would conceive of the risk primarily in terms of the information provided to them, allowing valence to be more easily manipulated.

The positive and negative versions of the questionnaire differed in two ways. First, all participants read an introductory paragraph about the health issue that highlighted either the factors that reduce a person's risk (e.g., the benefits of low homocysteine levels; positive valence condition), or the factors that increase risk (e.g., the impact of high homocysteine levels; negative valence condition); this text differed in only a few key phrases in order to maintain equivalence across all dimensions other than valence. Second, participants were asked to rate the likelihood of either a positive outcome (e.g., avoiding heart problems) or a negative outcome (e.g., developing heart problems).

Consistent with the previous research, the results revealed a valence effect: the negative condition elicited significantly greater UO than the positive condition. This occurred using both the direct (Gold & Martyn, 2003) and indirect (Gold & Martyn, 2004) methods of measuring UO.

The Motivational Model of the Valence Effect

Gold and Martyn (2003, 2004) used Kahnneman and Tversky's (1979) Prospect Theory to explain the valence effect in terms of motivational processes. Prospect theory holds that people evaluate prospective outcomes relative to a neutral reference point; an outcome implies either a gain or a loss depending on the salient frame of reference (Kahneman & Tversky, 1979; Tversky & Kahnneman 1981). However, individuals do not give equal weight to prospective gains and losses. Rather, losses are more aversive than objectively equivalent gains are desirable (Galanter, 1990; Tversky & Kahnneman, 1981).

Gold and Martyn (2003) reasoned that a positively framed event (e.g., the prospect of avoiding heart problems) is likely to be interpreted as a gain, whereas a negatively framed event (e.g., the prospect of developing heart problems) is likely to be interpreted as a loss. Given the importance individuals place on prospective losses, a negatively framed event may therefore have a greater psychological impact than its positively framed equivalent. If UO serves to bring people comfort, as proposed by the motivational account of UO, then a negatively framed event should motivate UO to a greater extent. Thus, according to Gold and Martyn's (2003) explanation, a valence effect is evidence that motivational processes contribute to UO in a given sample.

The Cognitive (Numerosity) Model of the Valence Effect

Studies by Price (2001) and by Price, Smith, and Lench (2006), although not in direct response to Gold and Martyn's (2003, 2004) work, nevertheless raise an alternative, cognitive explanation of the valence effect. This explanation hinges on evidence regarding a group size effect on probability estimates.

In their studies, Price (2001) and Price et al. (2006) asked participants to consider a series of groups of other individuals. These groups were represented in three different ways. In some studies, participants viewed photos showing various groupings of anonymous university students (Price et al., 2006, Studies 1-3); other studies involved providing participants with written descriptions of fictional group members (Price, 2001); in yet another variation, participants viewed groups of stick figures and were asked to imagine that each stick figure represented a randomly selected student from the participants' own university (Price et al., 2006, Study 4).

Group size was manipulated in these studies by varying the number of individuals included in each stimulus group, such that each participant viewed several different group sizes. For each group, participants were asked to judge the probability that the average member would experience various target events (e.g., developing cancer, having a long and happy marriage, or owning a white car). It was found that with all three types of group stimuli (photographs, written descriptions, and stick figures) probability estimates increased with the size of the group, the relationship between these variables being approximately log-linear.

Interestingly, this group size effect occurred for a variety of events, regardless of their valence. Probability estimates concerning positive, negative, and neutral events all increased with group size. Furthermore, Price et al. (2006, study 5) found that this effect was not limited to judgements of probability: when participants viewed groups of stick figures that varied in height, and judged the average height of each group, these estimates also increased with group size.

Price et al. (2006) argued that this phonemenon is best explained in terms of the numerosity heuristic. The existence of the numerosity heuristic was proposed by Pelham, Sumarta, and Myaskovsky (1994). These authors found evidence for a cognitive strategy whereby the number of units into which a stimulus is divided is used to arrive at quantitative estimates about that stimulus: an inference is made from how many of something there are, to how much of it there is. For many judgements, numerosity may offer a useful shortcut, given that number and quantity are usually positively correlated (Pelham et al., 1994). For example, the amount of wood in an area of forest can often be quickly estimated, to a fair degree of accuracy, by reference to the number of trees. However, because the numerosity heuristic operates relatively automatically, it may also be misapplied or overused (Pelham et al., 1994; Price et al., 2006). Indeed, it has been shown that, under certain conditions, people will over-estimate the quantity of a stimulus from its numerosity. For example, Pelham et al. (1994) showed that people judge the area of a circle to be greater when it is divided into several slices than when it is whole. They also demonstrated a similar effect for probability judgements: participants preferred one large risk to an equivalent series of small risks, suggesting that they inferred the overall risk from the number of individual risky events presented.

Price et al. (2006) proposed that a similar process may underlie the group size effect found in their studies: in using the numerosity heuristic, participants may over-estimate the probability of the average group member from the number in that group. This, they argued, explains why estimates of average group probability increased with group size. According to Price et al., the numerosity heuristic may also affect UO, given that UO judgements also involve estimating the risk of the average person from a group of others. The numerosity heuristic would be expected to inflate other-estimates, but have no effect on self-estimates.

This implies an alternative explanation of the valence effect (Price et al., 2006). For negative events, numerosity will widen the gap between participants' estimates, and thus contribute to UO (see Figure 1). However, the reverse is true for positive events: here, numerosity will close the gap between the estimates, counteracting UO (see Figure 2). Because the standard UO paradigm typically involves a large comparison group (e.g., 'other undergraduates'), UO will be large in the case of negative events, but small in the case of positive events. Thus, the valence effect can be explained, in entirely cognitive terms, by the differential effect of numerosity on UO for positive and negative events.

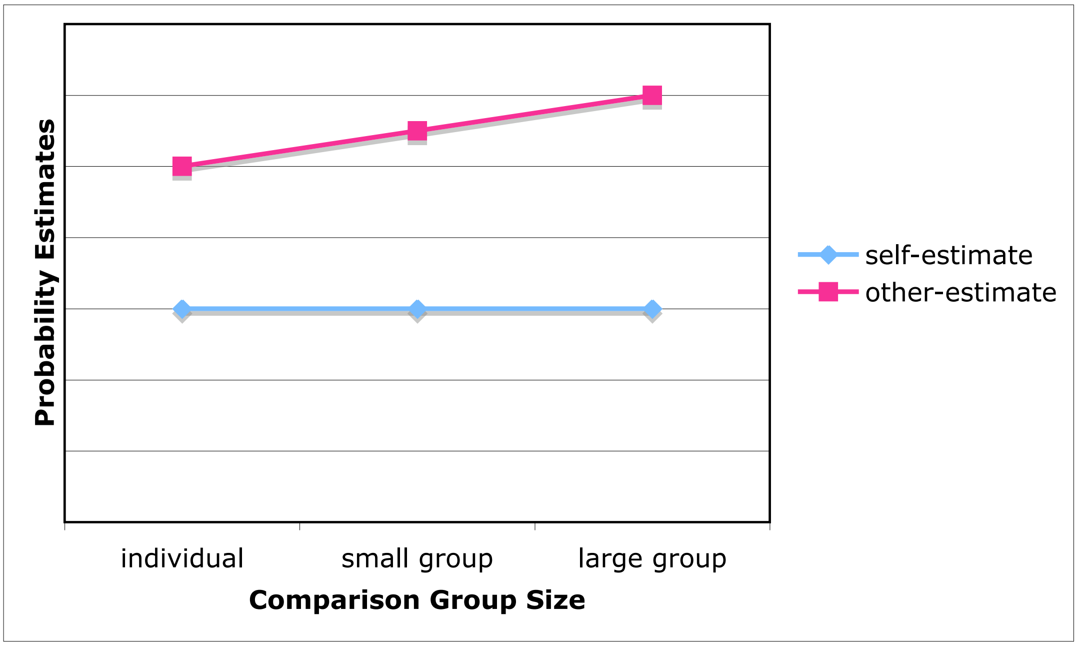

Figure 1. Self- and other-estimates as a function of comparison group size, for negative events, as predicted by the numerosity model.

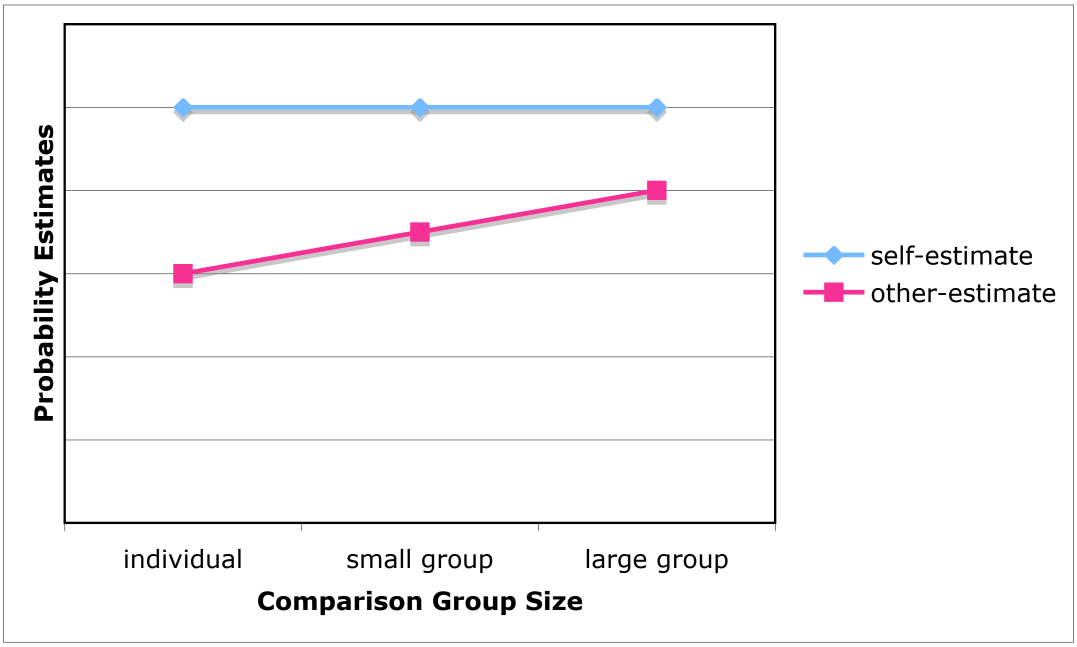

Figure 2. Self- and other-estimates as a function of comparison group size, for positive events, as predicted by the numerosity model.

Evaluating The Two Models of The Valence Effect

It can be argued that, on the evidence to date, the numerosity model has slightly more empirical support than the motivational model. Whereas Gold and Martyn (2003, 2004) merely inferred motivational processes from the valence effect on UO, Price et al. (2006) provide direct evidence for a specific cognitive mechanism: group size has been shown to affect probability estimates in a way that could explain the valence effect. The weakness of the numerosity model, however, is that it is unclear whether the group size effect will generalise beyond the methodology used by Price et al. One particular inconsistency between Gold and Martyn's findings and the numerosity model suggests that it may not.

Recall that responses to a direct question are dominated by participants' judgements of self-risk, whereas UO measured indirectly reflects judgements of both self- and other-risk equally (Aucote & Gold, 2005; Eiser et al., 2001; Klar & Giladi, 1997). The numerosity heuristic can only affect judgements of other-risk. Therefore, if the numerosity model is correct, then the valence effect should be greater using the indirect method than the direct method. Yet, Gold and Martyn (2004) found that the valence effect occurred just as much with the indirect as with the direct method. This implies that, contrary to the numerosity model, the valence effect in the standard UO paradigm occurs via an effect on judgements of self-risk.

Limits on the Generalisability of the Numerosity Model

There are further reasons to believe that group size effects may not generalize beyond the methodology employed by Price et al. (2006). Their approach seems likely to have been more conducive to numerosity effects than is the standard UO paradigm. Three aspects of their design seem particularly relevant.

Method of Presenting Groups

Price et al. (2006) acknowledged that presenting group information visually (in Price et al., 2006) and providing descriptions of each individual group member (in Price, 2001) were likely to make numerosity particularly salient. However, in the standard UO paradigm, the comparison group is typically described verbally, in general terms, without explicitly mentioning group size (e.g., "What is the chance that the average undergraduate student will experience X?"). Therefore, in the standard UO paradigm, participants may not focus very much at all on the size of the comparison group.

Repeated Measures Design

The use of a repeated measures design may have further heightened the salience of group size. Price (2001) asked each participant to make judgements about two to three different groups varying in size; Price et al. (2006) had each participant rate four groups varying in size. It seems plausible that, in this situation, the fact that group size was varying across displays may have further heightened group size salience.

Cognitive Load Imposed

The methodology used by Price (2001) and Price et al. (2006) required that participants consider a group of specific individuals then spontaneously calculate the group's average probability of experiencing the target event. In the studies in which group photos served as the stimuli (Price et al., 2006, studies 1-3), participants needed to estimate each individual's probability from their visible risk factors (e.g., gender, age, race, etc.), then compute a group average. A similar mental process would have been involved in the studies that provided participants with written descriptions of group members (Price, 2001). Here, participants needed to identify the relevant factors in each description, arrive at an estimate for each group member, and then average these estimates. When stick figures were used to represent randomly selected people (Price et al., 2006, Study 4), it is plausible that participants felt that they were required to imagine specific individuals. Again, in this situation, participants would need to mentally average the risk of a set of specific individuals. However, in the standard UO paradigm, participants typically consider a familiar and general group (e.g., 'undergraduate students') for which the participants are likely to have a pre-existing prototype. Spontaneously averaging a group of specific individuals seems likely to create a higher cognitive load than judging a general group. This is significant because the numerosity heuristic has been shown to have a greater effect under high cognitive load (Pehlem et al., 1994).

Testing Between the Two Models

Given the doubts raised about the generalisability of the numerosity model, further research is needed to determine which explanation of the valence effect is most appropriate. There are two approaches that may be useful.

Replicating group-size effects in the standard UO paradigm

One approach would involve attempting to replicate group-size effects on UO using a methodology closer to the standard UO paradigm. This could be achieved by assessing UO in relation to comparison groups of various sizes, with the size of each group conveyed verbally, as part of the standard UO questions. To better approximate the standard UO paradigm, a between-groups design could be used, with each participant considering only one comparison group. Detecting a group size effect using this approach would bolster support for the numerosity model.

Testing for the valence effect on separate self- and other-estimates

It would also be useful to clarify whether the valence effect occurs on judgements of self- or other-risk. This could be determined by replicating the valence effect using the indirect method, then looking for effects on self- and other-estimates separately. The numerosity model predicts a valence effect only on other-estimates. Therefore, a valence effect found on self-estimates would be strong evidence against the numerosity model.

The Proposed Study

It is proposed to undertake a study that combines these two approaches. This study will involve a 2 (event valence) X 3 (group size) between-groups design in which indirectly measured UO as well as its component self- and other-estimates will serve as dependent variables. Participants will begin by reading information (adapted from Gold and Martyn, (2004)) concerning the link between the amino acid homocysteine and heart problems in later life. To manipulate valence, this information will highlight either the dangers of high homocysteine levels (negative valence conditions), or the benefits of low homocysteine levels (positive valence conditions). Participants will be asked to provide both self- and other-estimates regarding the probability of developing (negative valence) or avoiding (positive valence) homocysteine-related heart problems later in life. Group size will be manipulated as part of the question requiring an other-estimate.

Implications of the Motivational and Cognitive Explanations of the Valence Effect

Determining which explanation underlies the valence effect has some important implications. If the valence effect were found to be motivational in nature, then this would bolster support for the motivational account of UO more generally; it would show that motivation at least partially underlies UO in some circumstances. It would also mean that valence manipulations can be used to test for a motivated component of UO regarding specific events in specific populations. For example, Gold (2006) found a valence effect on UO regarding the risk of HIV in a sample of undergraduate students, but not in a sample of gay men. On this basis, he argued that the motivational account better explains students' UO regarding HIV, whereas the cognitive account better explains the UO of gay men. Evidence supporting the motivational model of the valence effect would validate the findings of that study.

There may also be implications for health promotion. The valence effect implies that it may be useful to frame health messages positively, in order to reduce individuals' UO about health risks (Gold, 2006). For example, a health campaign may be more effective if it emphasises the health benefits of an active lifestyle, rather than the dangers of a sedentary one. Of course, this assumes that using positively framed messages to reduce UO will in turn affect individuals' health behaviours. However, this assumption may be quite reasonable if the valence effect is found to occur via an effect on self-estimates, as is possible under the motivational model. It is well established that beliefs about self-risk will influence behaviour: the Theory of Planned Behaviour (Ajzen 1991), the Health Belief Model (Janz & Becker, 1984), and Subjective-Expected Utility Theory (Ronis, 1992) all describe a role for this type of variable. However, message framing may have less or no influence if the numerosity model holds. The numerosity model predicts a valence effect only on other-estimates, and it is difficult to see why beliefs about others' risk should affect an individual's behaviour much at all (Price et al., 2006).

Conclusion

In summary, the valence effect on UO can be explained in terms of both the motivational and cognitive accounts. The motivational explanation holds that the valence effect occurs because negative events elicit greater motivation for UO; the cognitive explanation proposes that the valence effect is a side effect of the numerosity heuristic. Both models are plausible. However, the numerosity model is inconsistent with some of the previous data, and there are reasons to believe that numerosity effects might not generalise to the standard UO paradigm. Understanding what causes the valence effect is relevant to understanding UO generally, but may also have implications for health promotion. Therefore, a study aiming at replicating a group size effect within the standard paradigm is proposed. The study will also test whether the valence effect occurs on other-estimates (as predicted by the numerosity model) or self-estimates (as is possible under the motivational model).

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Chapter 2

Empirical Report

Abstract

People typically display ‘unrealistic optimism’ (UO) regarding future events: they believe they are more likely than average to experience positive (i.e., desirable) events, and less likely than average to experience negative (i.e., undesirable) events. A recent study demonstrated a valence effect on UO, whereby negatively ‘framed’ events elicited greater UO than their positively framed equivalents. Two alternative explanations for this valence effect have been proposed. One explanation holds that individuals are *motivated* to display greater UO for negative events, because they wish to avoid these events more strongly than they wish to experience equivalent positive events. An alternative explanation holds that the valence effect is a by-product of a group size effect on comparative risk judgements, resulting from use of the ‘numerosity heuristic’. The present study sought to test between these explanations. Deakin University students (N = 139) were assessed for UO regarding their chance of experiencing a type of heart problem later in life. Event valence was manipulated by framing this risk in either a positive or negative light; group size was manipulated by requiring participants to compare their risk with the average person in a group of either 40, 200, or 1000 other Deakin students. A two-question measure of UO was used, with one question concerning own risk, the other concerning that of the average person. The results revealed that the sample as a whole exhibited UO; the valence effect on UO was also evident. However, no group size effect on UO was found. Furthermore, the valence effect was found to occur via an effect on judgements of own risk but not on judgments concerning the average person. These findings suggest that the valence effect is better explained in terms of motivational processes than as a by-product of the numerosity heuristic. Implications for understanding UO and for health psychology are discussed.

‘Unrealistic optimism’ (UO) refers to an anomaly in individuals’ expectations about the future: people typically believe they are more likely to experience positive (i.e., desirable) events, and less likely to experience negative (i.e., undesirable) events, than the average person like themselves (Weinstein, 1980, 1987). Although this may be true for any one individual, it is generally unrealistic for a majority to hold this belief. Logically, unless the objective distribution of probability is heavily skewed, a majority cannot have better-than-average chances (Weinstein). Therefore, UO is held to reflect a bias in judgement, evident whenever a group, as a whole, judges its chances to be better than average.

UO occurs for a broad range of events, including the prospect of being murdered (Weinstein, 1987), contracting breast cancer (Absetz, Aro, Rehnberg & Sutton, 2000), and finding a job on the internet (Campbell, Greenauer, Macaluso & End, 2007). The importance of UO stems largely from the possibility that it may make individuals less willing to take steps to protect against risks (Absetz, 2000; Gold & Aucote, 2003; McKenna, 1993; Weinstein, 1987 Wendt, 2005). This possibility has motivated much research seeking to shed light on the causes of UO and to identify factors that might reduce its impact. Often, this research has focused on variables that moderate UO. Explaining the influence of one such variable – event valence – was the focus of the present study.

‘Event valence’ refers to whether an event is generally considered positive or negative. Although UO occurs for events of either valence, in several early studies, negative events were found to elicit greater UO (Eiser, Pahl, & Prins, 2001; Hoorens, 1995; Weinstein, 1980; Zakay, 1996). However, these studies suffered from an important limitation: the positive and negative events used in these studies were not matched on all other relevant characteristics; thus, valence was potentially confounded with other variables (Gold & Martyn, 2003).

Recently, Gold and Martyn (2003, 2004) put the relationship between event valence and UO to a more robust test. They conducted studies in which they experimentally manipulated the valence of a single event and examined the effects on UO. In these studies, participants were introduced to a little-known yet significant health risk (e.g., the effect of the amino acid homocysteine on the chance of experiencing heart problems later in life). In order to manipulate event valence, the health risk was ‘framed’ in either a positive or a negative light. This was achieved in two ways. First, participants were provided with matched information about the health issue that highlighted either the factors that reduce risk (e.g., the benefits of low homocysteine levels), or the factors that increase risk (e.g., the impact of high homocysteine levels). Second, participants were asked to rate their comparative likelihood of either a positive outcome (e.g., avoiding heart problems) or a negative outcome (e.g., developing heart problems). Consistent with the earlier research, these studies revealed a valence effect: negative events elicited significantly greater UO than did their positive equivalents.

Two different explanations for this valence effect have been proposed. One explanation, originating from Gold and Martyn (2003), combines the motivational account of UO (Kirscht, Haefner, Kegeles, & Rosenstock, 1966; Weinstein, 1980, 1987) with Kahneman and Tversky's (1979) Prospect Theory.

The motivational account of UO holds that people adopt optimistic beliefs about the future to bring themselves comfort. In particular, UO is thought to arise in response to the anxiety aroused by the prospect of experiencing a negative outcome or failing to experience a positive outcome (Kirscht et al.; Weinstein, 1980). One way this might occur is via 'motivated reasoning', a process in which individuals selectively employ reasoning strategies in order to arrive at a desired conclusion (Kunda, 1987, 1990). By this means, individuals may emphasise to themselves certain factors, and downplay others, to support the UO conclusion. In this sense, UO is held to be motivational.

Prospect Theory holds that people evaluate prospective outcomes relative to a neutral reference point; an outcome implies either a gain or a loss depending on the salient frame of reference (Kahneman & Tversky, 1979; Tversky & Kahneman 1981). However, it has been found that individuals do not give equal weight to prospective gains and losses. Rather, losses are more aversive than objectively equivalent gains are desirable (Galanter, 1990; Tversky & Kahneman, 1981).

Assuming that participants see negative events as implying potential loss and positive events as implying potential gain, Prospect Theory implies that individuals may feel a greater desire to believe themselves unlikely to experience a negative event than to believe themselves likely to experience an equivalent positive one. Thus, if UO reflects motivated reasoning, the valence effect may occur simply because individuals feel greater motivation to draw the UO conclusion in the case of a negatively-framed event. This proposal will be referred to hereafter as the 'motivational model' of the valence effect.

An alternative, and somewhat more complex explanation, arises from a group of studies by Price, Smith, and Lench (2006). In these studies, Price et al. presented participants with a series of images representing groups of other people. The size of these groups was varied by including a different number of people in each group. Participants were asked to judge the likelihood that the average member of each stimulus group would experience various target events. It was found that estimates concerning positive, negative, and neutral events all increased with group size.

Price et al. (2006) attributed this group size effect to participants' use of the 'numerosity heuristic'. The existence of the numerosity heuristic was proposed by Pelham, Sumarta, and Myaskovsky (1994). These authors found evidence for a cognitive strategy whereby the number of units into which a stimulus is divided is used to arrive at quantitative estimates about that stimulus: an inference is made from how many of something there are, to how much of it there is. For many judgements, this heuristic offers a useful shortcut. However, it can also be misapplied or overused (Pelham et al.; Price et al., 2006). For example, Pelham et al. showed that people judge the area of a circle to be greater when it is divided into several slices than when it is whole. Price et al. proposed that the group size effect found in their studies could also be explained in terms of the numerosity heurstic: participants may have estimated the probability of the average group member from the number in that group; thus, estimates of average group probability increased with group size.

According to Price et al. (2006), this type of numerosity effect suggests an alternative explanation for the valence effect on UO. In the standard UO paradigm, UO is commonly assessed via a two-question measure: one question asks the participant to rate his/her own likelihood of an event (a self-estimate), while the other asks the participant to rate the likelihood of the average person from a comparison group to which he/she belongs (an other-estimate). UO is then calculated as the difference between these estimates. Because other-estimates typically concern a large comparison group (e.g., "other Deakin University students"), the numerosity heuristic might lead participants to inflate these estimates. For negative events, this would contribute to the difference between self- and other-estimates, increasing UO (see Figure 3). However, for positive events, it would reduce the difference between these estimates, counteracting UO (see Figure 4). UO would therefore be greater for negative events than positive events. Thus, the valence effect on UO can be explained as an unmotivated by-product of participants' use of the numerosity heuristic. This explanation will be referred to hereafter as the 'numerosity model' of the valence effect.

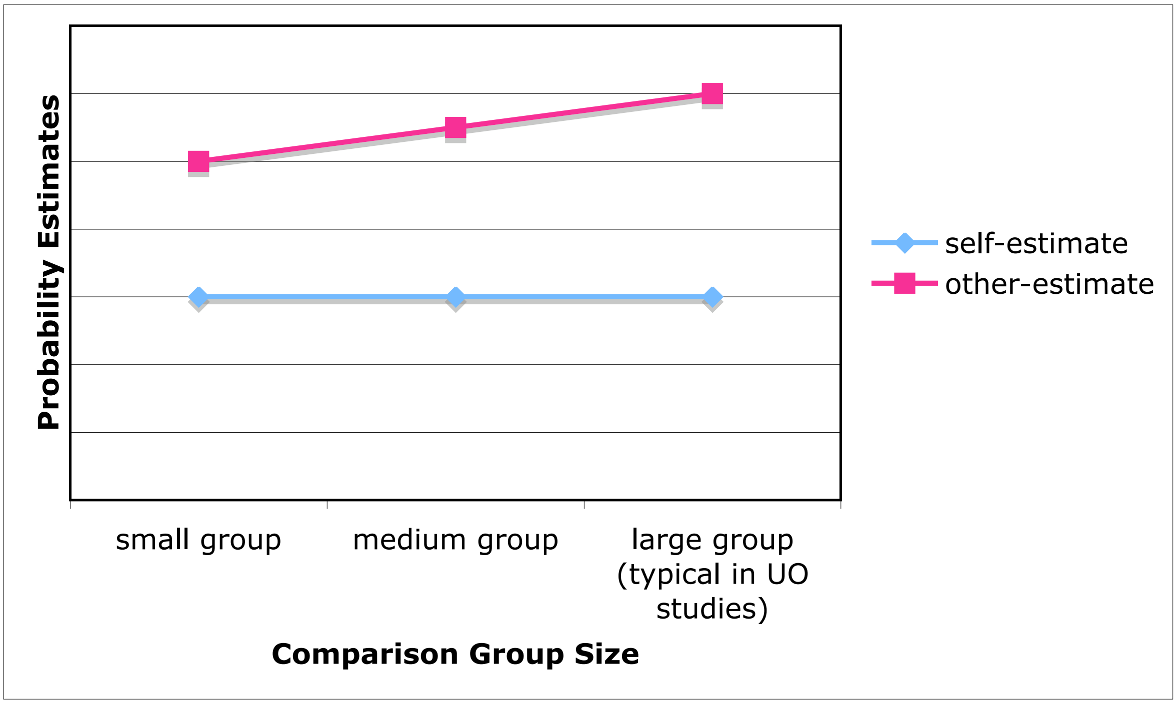

Figure 3. Self- and other-estimates as a function of comparison group size, for negative events, as predicted by the numerosity model.

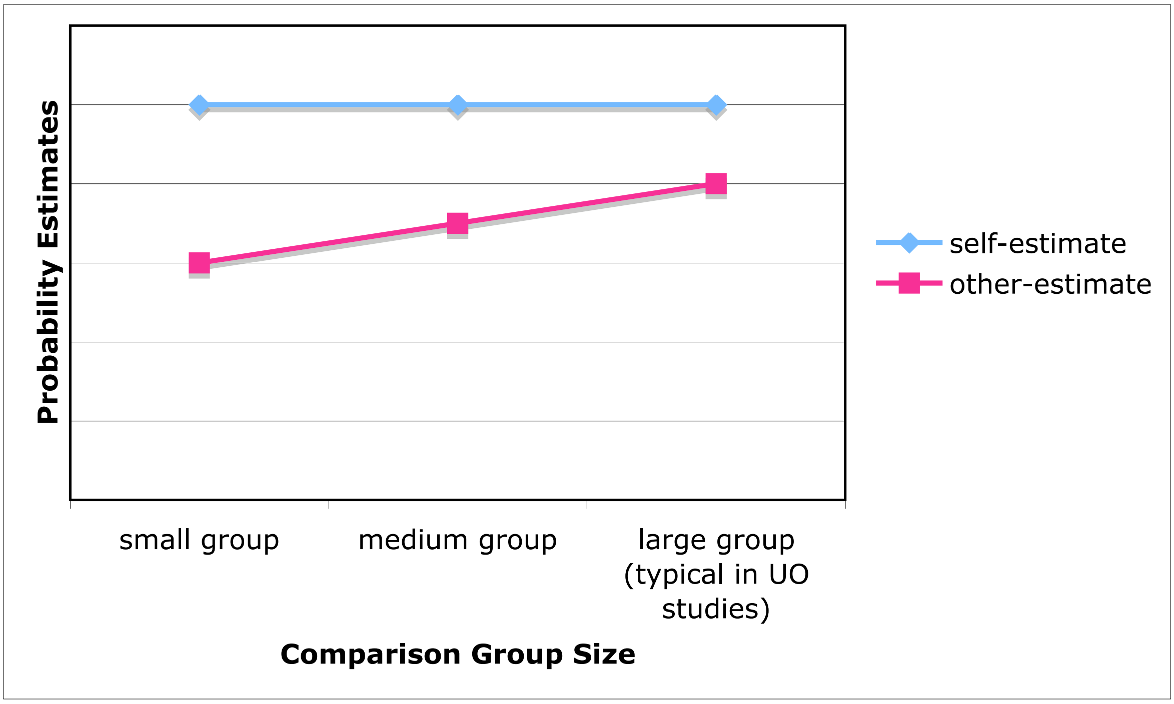

Figure 4. Self- and other-estimates as a function of comparison group size, for positive events, as predicted by the numerosity model.

There are two approaches that might be usefully employed to test between the motivational and numerosity models. One approach stems from the observation that the methodology used by Price et al. (2006) departed considerably from the standard UO paradigm. It did so in two ways. First, numerosity seems likely to have been more salient in Price et al.'s studies than in the standard UO paradigm. For example, Price et al. presented groups visually such that group size was clearly apparent, whereas in the standard UO paradigm comparison groups are typically described in general terms, without explicit reference to group size. Furthermore, Price et al. manipulated group size as a within-subjects variable; the fact that group size varied across displays may have further heightened its salience. Second, participants in Price et al.'s studies seem likely to have made risk judgements under a higher cognitive load than is typical in the standard UO paradigm. They were required to derive other-estimates from photographs depicting groups of specific individuals. They therefore needed to estimate each individual's probability from their visible risk factors (e.g., gender, age, race, etc.), then mentally compute a group average. This task seems likely to impose a higher cognitive load than would simply judging a general comparison group (e.g., 'undergraduate students'). This is important because the numerosity heuristic has been shown to be employed to a greater extent under high cognitive load (Pehlem et al., 1994).

For these reasons, it is unclear whether the group size effect will generalise to the standard UO paradigm. It would therefore be useful to investigate whether it does so generalise. This could be achieved by assessing UO in relation to comparison groups of various sizes, described in general terms, with the size of each group conveyed verbally as part of the standard UO questions. To better approximate the standard UO paradigm, a between-groups design could be used, with each participant considering only one comparison group. Detecting a group size effect using this approach would bolster support for the numerosity model.

Another approach to testing between the models would involve determining whether the valence effect on UO occurs via an effect on self-estimates or on other-estimates. Under Gold and Martyn's (2003) motivational model, a valence effect on either type of estimate is plausible. In contrast, the numerosity model predicts that the valence effect on UO occurs solely via an effect on other-estimates (Price et al., 2006). Therefore, if a valence effect were found on self-estimates but not other-estimates, this would provide strong evidence against the numerosity model.

The present study combined these two approaches to testing between the models. Group size was manipulated verbally as part of the standard UO questions, and event valence was manipulated using the ‘framing’ technique used by Gold and Martyn (2003, 2004). As in Gold and Martyn’s studies, the risk of homocysteine-related heart disease was employed as the target event. A two-question measure of UO (requiring separate self- and other-estimates) allowed UO as well as its component estimates to serve as dependent variables.

Several hypotheses were tested. As a preliminary hypothesis, it was predicted that the sample, as a whole, would exhibit UO (Hypothesis 1). It was further hypothesised that there would be a valence effect on UO, with UO being greater in the negative condition than the positive condition (Hypothesis 2).

The remaining hypotheses were designed to test between the two alternative models of the valence effect. It was hypothesised, on the basis of the numerosity model, that there would be a valence X group size interaction on UO. Specifically, UO was predicted to increase with group size for the negatively-framed event, but decrease with group size for the positively-framed event (Hypothesis 3). It was also hypothesised, again on the basis of the numerosity model, that there would be a main effect of valence on other-estimates – such that these would be greater in the negative condition than in the positive condition – but no effect of event valence on self-estimates (Hypothesis 4).

Method

Participants

Participants were undergraduate students from Deakin University, recruited in classes. Participation was voluntary and no payment was offered. Prior to coding, one case was removed for having not provided an other-estimate. The final sample comprised 139 participants (117 females and 27 males). Their ages ranged from 17 to 41 years, with an average age of 20.53 (SD = 3.94 years).

Design

Each participant gave both a self-estimate and an other-estimate. Three factors were fully crossed: comparison group size (40, 200, 1000), event valence (positive or negative), and question order (self- then other-estimates, or other- then self-estimates). Participants were randomly assigned to receive a questionnaire booklet corresponding to their experimental condition.

Materials and Procedure

Ethics approval was given by the Deakin University Human Research Ethics Committee (see Appendix A). Data were collected by the student researcher in undergraduate classes. All participants were provided with a questionnaire booklet (see Appendix B for a sample questionnaire). They also received a plain language statement that provided information on the purpose of the study and the procedure to be employed (see Appendix C).

Health Threat Information. After noting their age and gender in their questionnaire booklets, participants read a short paragraph (adapted from Gold and Martyn, 2003) about homocysteine-related heart problems. This information was 'framed' either positively or negatively via the wording of certain key phrases. These phrases are italised below, with the positively-framed version in parentheses.

> A recent study by the University of Washington has suggested that having a *high (low)* level of the amino acid homocysteine when you are young *makes you vulnerable to (safeguards you against)* developing heart problems later in life. The researchers claimed that *unsafe (safe)* levels of homocysteine *lead to (would prevent)* as many as 50,000 heart attack deaths in the USA a year. The vitamin, folic acid, found in green leafy vegetables, beans and citrus fruits, breaks down homocysteine. *Failing to eat (Eating)* adequate amounts of these foods *is thus dangerous for health (thus acts as a protective shield);* it greatly increases the likelihood of *becoming ill with heart disease (having a healthy heart)* later.

Self- and Other-estimates. After reading this information, participants answered two questions concerning the probability of "developing" (negative condition) or "avoiding" (positive condition) homocysteine-related heart problems. One question required a self-estimate; it asked, "What do you think is your likelihood of *developing (avoiding)* homocysteine-related heart problems later in life?"

Another question required an other-estimate; group size was manipulated as a part of this item. The question read as follows:

> A *small (medium sized, large)* sample of Deakin students have been randomly selected to take part in a 'Deakin Health Study', to commence later this year. *40 (200, 1000)* students will take part in that study.
>
> What do you think is the likelihood that the average student taking part in this study will *develop (avoid)* homocysteine-related heart problems later in life?

Both self- and other-estimates were made on 7-point Likert scales, with 1 marked as "not at all likely" and 7 marked as "extremely likely".

Manipulation Check. A final question served as a manipulation check for the group size manipulation. This item was printed on the back page of the questionnaire booklet, separated from the previous questions; participants were asked not to turn back to look at earlier questions. The question read, "Can you now please guess how many of the students who will take part in the Deakin Health Study will *develop (avoid)* homocysteine-related heart problems later in life." Participants were asked to write their response as a whole number in the space provided.

Results

Self- and other-estimates were coded on a scale from 1 to 7. To allow for comparisons between estimates made in the positive and negative conditions, self- and other-estimates given in the positive condition were reverse coded. Therefore, regardless of the valence condition, and for both types of estimates, higher ratings always indicated greater risk.

Unrealistic Optimism. UO scores for each participant were calculated by subtracting self-estimates from other estimates; thus, for all participants, positive scores indicated relative optimism. The mean UO score was .38 (SD = 1.43). Consistent with Hypothesis 1, this value was significantly greater than zero, ($t(139) = 3.14$, $p = .002$), indicating that the sample as a whole exhibited UO. UO scores did not correlate significantly with age ($r = -.06$, $p =.445$), nor did they differ significantly between genders, ($t(137) = 1.61$, $p = .109$). Accordingly, gender and age were excluded from further analyses.

UO scores were submitted to a 3 (Group size) X 2 (Valence) X 2 (Question order) ANOVA. The full results of this analysis are presented in Table 1 of Appendix D; group means, across valence and group size conditions, are represented below in Figure 5.

Figure 5. UO for the positively and negatively framed events as a function of comparison group size (collapsed across question order).

From Figure 5, it can be seen that, consistent with Hypothesis 2, UO was greater for the negatively-framed event (M = .88, SD = 1.32) than the positively-framed event (M = -.05, SD = 1.39). This valence effect was significant, ($F(1,127) = 16.876$, $p < .001$).

It can also be seen that, contrary to Hypothesis 3, the predicted interaction effect between valence and group size on UO did not occur: UO did not consistently increase with group size for the negatively-framed event, nor decrease with group size for the positively-framed event. Indeed, there was no significant valence X group size interaction on UO whatsoever, ($F(2,127) = 1.95$, $p = .147$).

Manipulation Check. Responses to the manipulation check item were examined for indications that participants had in fact noted the group size information provided to them. Of the 139 participants, six (2.3%) gave responses in a format inappropriate to the question (e.g., providing a percentage rather than number). Of the remaining 133 responses, the trend was for estimates to increase with group size: the mean estimates from participants in the small, medium, and large group size conditions were, respectively 38.83 (*SD* = 75.31), 88.04 (*SD* = 85.646), and 304.64 (*SD* = 346.95). Because larger group sizes allowed for a greater range of plausible responses, there was a considerable heterogeneity of variance between groups, precluding parametric tests of the statistical significance of these differences. However, the great majority of estimates were limited to the range appropriate for their group size condition: 85% of participants in the small group size condition (group stated to include 40 students) gave estimates between 0 and 40; 96% in the medium group size condition (group stated to include 200 students) gave estimates between 0 and 200; and 98% in the large group size condition (group stated to include 1000 students) gave estimates between 0 and 1000. Thus, most participants appear to have noted and recalled the group size information provided to them.

Other-estimates. Other-estimates were submitted to a 3 (Group size) X 2 (Valence) X 2 (Question order) ANOVA. The full results are presented in Table 2 of Appendix D; group means, across valence and group size conditions, are represented below in Figure 6.

Figure 6. Other-estimates as a function of comparison group size for the positively-framed and negatively-framed event (collapsed across question order).

From Figure 6, it can be seen that participants in the negative condition judged the ‘average’ person to be at somewhat less risk (*M* = 3.68, *SD* = 1.23) than did participants in the positive condition (*M* = 4.0, *SD* = 1.01). Although this effect approached significance, ($F(1,127) = 3.148$, $p = .078$), the trend is in the opposite direction to that predicted as part of Hypothesis 4; it thus weakened, rather than contributed to, the valence effect on UO.

The only significant result regarding other-estimates was a main effect of question order, ($F(2,127) = 4.185$, $p = .029$). Participants judged the average Deakin student to be at less risk when the other-estimate was given first (*M* = 3.66, *SD* = 1.26) than when the self-estimate was given first (*M* = 4.04, *SD* = .93).

Self-estimates. Self-estimates were submitted to a 2 (Valence) X 2 (Question order) ANOVA. The full results are presented in Table 1 of Appendix D; group means, across valence and question order conditions, are represented below in Figure 7.

Figure 7. Self-estimates across valence and question order conditions.

From Figure 7, it is seen that participants in the negative condition judged themselves to be at less risk (*M* = 2.8 *SD* = 1.06) than did participants in the positive condition (*M* = 4.05, *SD* = 1.28). This difference is in a direction that would contribute to the valence effect on UO. Contrary to Hypothesis 4, this valence effect on self-estimates was significant, ($F(1,135) = 39.92$, $p < .001$).

It is also seen that participants typically judged themselves to be at greater risk when self-estimates were given first (M = 3.72, SD = 1.35) than when self-estimates were given second (M = 3.21, SD = 1.28). This main effect of question order on self-estimates was significant ($F(1,135) = 6.23$, $p = .014$).

Discussion

The present study was designed to test between the motivational and numerosity models of the valence effect. Several hypotheses were tested.

Hypotheses 1 and 2 concerned the prerequisite conditions needed to test between the two models. Both these hypotheses were confirmed. First, the sample, as a whole, was found to exhibit UO. Second, there was a valence effect on UO, consistent with the findings of Gold and Martyn (2003, 2004).

Hypothesis 3 concerned the presence of a group size effect on UO. On the basis of the numerosity model, UO was predicted to increase with group size for the negatively-framed event, and decrease with group size for the positively-framed event. To test this prediction, participants were asked to compare their chance of experiencing a positively or negatively-framed event with that of the average person from a group of either 40, 200, or 1000 others. Although participants appeared to note the group size information provided to them, no group size effect on UO was found.

Having failed to detect this effect, one might question whether there was sufficient power to detect an effect if one were present. To address this question the power of the present study was calculated. It was determined that with a sample size of 139, the present study had a power of .95 to detect a moderately large group size effect (the minimum required R^2 associated with group size was calculated to be approximately .10). This appears to have been ample sensitivity to detect a group size effect of the magnitude found by Price et al. (2006) (see Appendix E for details).

Hypothesis 4 concerned whether the valence effect on UO occurs via an effect on self- or other-estimates. As Price et al. (2006) have noted, group size effects should apply only to judgements about the average person from a group. Therefore, under the numerosity model, a valence effect on UO must occur via an effect on other-estimates rather than self-estimates. However, in this study, the opposite was found: contrary to Hypothesis 4, there was a valence effect on self-estimates (in a direction that would create the observed valence effect on UO) but no valence effect on other-estimates.

It is seen, then, that the results of this study were inconsistent with all of the hypotheses derived from the numerosity model. In defence of the numerosity model, it could be argued that the group size manipulation used in this study may merely not have been conducive to a group size effect. For example, it is conceivable that the explicit provision of group size information might have somehow acted as a signal to participants to discount group size from their judgements; they may have realised that this information was irrelevant to the question asked of them. However, it is difficult to see how the numerosity model could account for the findings pertaining to Hypothesis 4: that the valence effect occurs via an effect on self- but not other-estimates. Overall then, this study provides strong evidence that the valence effect on UO is not merely a by-product of participants' use of the numerosity heuristic. The results are, however, entirely consistent with the motivational model. Therefore, this study supports the notion that UO is greater for negatively-framed events because these events elicit greater motivation for participants to draw the UO conclusion.

What are the implications of this finding? There may be several. To begin with, that the valence effect on UO appears to be motivational in nature bolsters support for the motivational account of UO more generally: it shows that motivational processes at least partially underlie UO in some circumstances. It also suggests that valence manipulations can be used to test for a motivated component of UO in specific cases. Indeed, this approach was employed by Gold (2006) in a study examining the causes of UO regarding HIV infection. In that study, a valence effect on UO was found in a sample of gay men, but not in a sample of undergraduate students. On the basis of these results, Gold argued that motivational processes contributed to the UO of the student sample, but not to that of the gay men. The present findings add support to that interpretation.

Another implication of this study concerns the importance that individuals may place on UO. If individuals are motivated to draw the UO conclusion, what is it that they find comforting about this idea? One possibility is that they are particularly concerned with their comparative risk, specifically wishing to believe that they are at lower risk than others. Alternatively, individuals may merely wish to believe that they are at low absolute risk, while being relatively unconcerned about others' risk; in this case, UO would occur simply because individuals would seek to under-estimate their own risk, but not that of others. The findings of this study are more consistent with the later possibility. Were individuals specifically concerned with their comparative risk, one would expect that they would not only seek to under-estimate their own-risk, but also seek to over-estimate others' risk: they would feel motivated to distort both self- and other-estimates. Because this motivation would be greater in regards to negative events than positive events, a valence effect on both types of estimate would be expected to occur. The absence of a valence effect on other-estimates in this study suggests that individuals may not be overly concerned with their comparative risk.

A practical implication of this study concerns the utility of positive message framing for health promotion. It has been suggested, on the basis of the valence effect, that it may be useful to frame health messages in a positive light in order to reduce individuals' UO regarding their health (Gold, 2006). This proposal is based on the assumption that UO makes people less inclined to take steps to protect themselves against risk.

However, the present findings suggest that positively-framed events elicit less UO merely because they evoke less anxiety. Most theories of risk behaviour (e.g., Protection Motivation Theory, Rogers, 1975) imply that people's motivation to reduce risk is determined to a large extent by their anxiety over the potential consequences of that risk. It seems plausible, then, that by adopting positive frames, health educators may not only reduce UO, but also inadvertently reduce individuals' motivation for the very protective measures that they ultimately wish to encourage. Positive framing may therefore be counterproductive. This suggests that it may be important for future research to examine the effects of event valence on a broader range of dependent variables. For example, future studies could test for valence effects, not only on participants' UO, but also on their intent to engage in protective behaviours after having made comparative risk judgements. This approach might provide some indication of whether the reduction of UO that can be achieved through positive framing is likely to lead to an overall improvement in health behaviour.

A final area for consideration concerns the relationship between event valence and judgements of comparative risk as they occur spontaneously in everyday life. In the standard UO paradigm, participants exhibit UO in response to questions specifically designed to elicit comparative judgements. However, it has also been found that, if asked to think aloud about their risk of an event, many individuals also *spontaneously* compare their risk with that of their peers in a manner consistent with UO (Gold, in press; Smith, 2006). This suggests that comparative risk judgements are a part of their everyday thinking.

How might these spontaneous UO judgements be formulated in terms of valence? Prospect Theory holds that outcomes will be viewed as either a loss or a gain (and by extension as either negative or positive) based on the salient frame of reference (Kahneman and Tversky, 1979). According to Tversky and Kahneman (1981), this reference point can be determined by a number of factors (including the status quo, one's expectations and aspirations, or social norms). For example, it seems plausible that with respect to health risks, an individual's current state of health would often serve as the frame of reference. Therefore, in the case of fairly healthy individuals, one might expect spontaneous judgements about health risks to commonly be formulated within negative frames (i.e., in terms of the chance of developing a disease or problem, rather than the chance of avoiding it). However, there may be circumstances in which other factors (e.g., an expectation of contracting a disease, or the consequences one attaches to contracting a disease) might determine the frame within which these judgements are formulated. Future research may wish to investigate this issue.

In summary, the present study provides insight into one of the event characteristics that moderate UO: event valence. Contrary to the numerosity model proposed by Price et al. (2006), the valence effect does not appear to be a by-product of the numerosity heuristic. Rather, the findings suggest that UO is greater for negative than positive events because the former elicit greater motivation for individuals to draw the UO conclusion. This finding provides support for the motivational account of UO, and validates the use of valence manipulations as a research tool for testing for a motivated component of UO. The present study also has wider implications. The results of this study suggest that people may not be overly concerned with their comparative risk, but merely concerned with their absolute level of risk. Furthermore, there is reason to question whether framing health messages positively will actually have a beneficial effect on health behaviours. Finally, given the apparent effects of event valence on UO, it seems important to establish the determinants of the frames within which spontaneous UO occurs. All these issues warrant further research.

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Appendix A – Ethics Approval

DEAKIN UNIVERSITY

DUHREC Subcommittee -Faculty of Health Medicine Nursingand Behavioural Sciences

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Memorandum

To	Assoc Prof Ron Gold School of Psychology	Date	28 March 2007
From	Chair – DUHREC Subcommittee, Faculty of Health Medicine Nursing and Behavioral Sciences		
Subject	DUHREC-HBS 04/07 ' Explaining Effects of Event Valence on Unrealistic Optimism'		

The application by Mark Brown has been considered by the DUHREC-H Subcommittee members, and has been **recommended for approval.**

Plain language statement and consent forms:
(i) Please insert the name and contact details of the Acting Chair in the complaint clause

Professor Caryl Nowson Acting Chair – Deakin University Ethics Subcommittee-HMNBS 221 Burwood Highway Burwood VIC 3125 Telephone (03) 925 17272 E-mail caryl.nowson@deakin.edu.au

The application is proceeding to the Deakin University Human Research Ethics Committee for ratification and, in the absence of any further advice, may commence.

An Annual Project Report Form has been attached which you will be required to complete in relation to this research. This should be completed and returned to the Administrative Officer to the DUHREC Subcommittee – Health & Behavioural Sciences, Burwood campus by **Monday 20th November, 2007** or when the project is completed.

Good luck with the project!

For Professor Bob Cummins, Deputy (acting) Chair
DUHREC Subcommittee – Health & Behavioural Sciences

cc: Mr Mark Brown
c/o School of Psychology

Appendix B – Sample Questionnaire

QUESTIONNAIRE

This is an anonymous questionnaire, so please do not write your name or any other form of identification on it.

Note that by completing the questionnaire you are consenting to participate.

Please make sure that you have read the Plain Language Statement before completing the questionnaire.

Could you start by recording your age and gender below:

Age: ______________

Gender: ______________

Please answer the questions in the order they appear.

Once you have turned a page, please do not turn back to an earlier page.

To start with, please read the following information very carefully.

A recent study by the University of Washington has suggested that having a low level of the amino acid homocysteine when you are young safeguards you against developing heart problems later in life.
The researchers claimed that safe levels of homocysteine would prevent as many as 50,000 heart attack deaths in the USA a year.

The vitamin, folic acid, found in green leafy vegetables, beans and citrus fruits, breaks down homocysteine.

Eating adequate amounts of these foods thus acts as a protective shield; it greatly increases the likelihood of having a healthy heart later.

Please take a moment to think about this information.

Now please answer the following questions.

A large sample of Deakin students have been randomly selected to take part in the 'Deakin Health Study', to commence later this year.
1000 students will take part in that study.

What do you think is the likelihood that the average student taking part in that study will avoid homocysteine-related heart problems later in life?

Give your answer by ticking a box on the scale below:

"It is…..

Not at all likely 1	2	3	4	5	6	Extremely likely 7
☐	☐	☐	☐	☐	☐	☐

….. that the average student in the Deakin Health Study will avoid homocysteine-related heart problems later in life".

What do you think is your likelihood of avoiding homocysteine-related heart problems later in life?

Give your answer by ticking a box on the scale below:

"I am…..

Not at all likely 1	2	3	4	5	6	Extremely likely 7
☐	☐	☐	☐	☐	☐	☐

….. to avoid homocysteine-related heart problems later in life".

Can you now please guess how many of the students who will take part in the Deakin Health Study will avoid homocysteine-related heart problems later in life:

Indicate your guess below. Please write a number, not a percentage.

"_____________________________ student(s) in the Deakin Health Study will avoid homocysteine-related heart problems later in life".

Thank you for your participation.

If you found any aspects of this study disturbing, you might wish to see the student counsellor on your campus.

Student Counsellor Burwood Campus: 9244 6300

Appendix C – Plain Language Statement

DEAKIN UNIVERSITY HUMAN RESEARCH ETHICS COMMITTEE

PLAIN LANGUAGE STATEMENT

This information sheet is for you to keep.

My name is Mark Brown. I am currently completing a Bachelor of Applied Science (Psychology)(Honours). As part of my course, I am conducting a research project under the supervision of Assoc. Prof. Ron Gold. The project aims to investigate students' perceptions of health risks. In the long term, the research may contribute to efforts to improve health education.

I invite you to participate in my research by completing a short questionnaire. It should take you no more than about 3-4 minutes to fill out. I foresee no particular discomfort or risks for you in taking part in the study.

Participation is voluntary; if you decide not to take part, there will be no negative consequences for you. All responses will be anonymous; your name will not be recorded. No individual responses will be reported; only group results will be used.

You may withdraw from the study at any time, up until the point when you hand in the completed questionnaire. If you withdraw, your responses will not be used.

Storage of the data collected will adhere to University regulations; the data will be kept in secure storage for 6 years.

A summary of the final results will be posted on your School notice board towards the end of Semester 2.

If you have questions regarding this study, please contact me, Mark Brown, or Assoc. Prof. Ron Gold at the School of Psychology on (03) 92446477.

Should you have any concern about the ethical conduct of this research project (DUHREC-HMNBS 04/07), please contact the Deakin University Ethics Subcommittee – HMNBS at the following address:
Chair – Deakin University Ethics Subcommittee-HMNBS
221 Burwood Highway, Burwood VIC 3125
Tel: +61-3-9251-7272 Email: caryl.nowson@deakin.edu.au

Appendix D – ANOVA results

Table 1.

Results of a 3 X (Group Size) X 2 (Valence) X 2 (Question Order) ANOVA on UO.

Source	*df*	*F*	*p*
Valence	1	16.876***	.000
Group Size	2	.13	.881
Question Order	1	.25	.618
Valence X Group Size	2	1.95	.147
Valence X Order	1	3.14	.079
Group Size X Order	2	1.63	.200
Valence X Group Size X Order	2	.37	.693
error	127	(1.82)	

Note. Values in parentheses represent mean square errors. * $p < .05$; ** $p < .01$; *** $p < .001$.

Table 2.

Results of a 3 X (Group Size) X 2 (Valence) X 2 (Question Order) ANOVA on other-estimates.

Source	*df*	*F*	*p*
Valence	1	3.15	.078
Group Size	2	2.26	.109
Question Order	1	4.85*	.029
Valence X Group Size	2	1.49	.229
Valence X Order	1	2.78	.098
Group Size X Order	2	.112	.894
Valence X Group Size X Order	2	.528	.591
error	127	(1.19)	

Note. Values in parentheses represent mean square errors. * $p < .05$; ** $p < .01$; *** $p < .001$.

Table 3.

Results of a 2 (Valence) X 2 (Question Order) ANOVA on self-estimates.

Source	*df*	*F*	*p*
Valence	1	39.92***	.000
Question Order	1	6.231**	.014
Valence X Order	1	.257	.613
error	135	(1.36)	

Note. Values in parentheses represent mean square errors. * $p < .05$; ** $p < .01$; *** $p < .001$.

Appendix E – Effect sizes in Price et al.'s (2006) studies

Although Price et al. (2006) did not report effect sizes for their studies, some indication of the magnitude of the group size effect in those studies can be obtained from the tests of statistical significance they reported. Price et al. analysed their results by regressing each participant's other-estimates onto the log of the stimulus group size and obtaining a regression coefficient for each participant. They then submitted the mean regression coefficient for each study to a one-sample *t*-test. An R^2 value associated with group size can therefore be calculated from the reported *t* values and degrees of freedom for error using the following formula:

$$R^2 = \frac{t^2}{t^2 + df_{error}}$$

Using this technique, the R^2 values associated with group size (for the four studies most analogous to the present study) were found to be .27 (Study 1), .36 (Study 2), .31 (Study 3), and .21 (Study 4).