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Are direct or indirect measures of comparative risk better predictors of concern and behavioural intentions?

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Recent research has shown that comparative risk perceptions account for unique variance in concern and behavioural intentions, above and beyond absolute self risk perceptions. However, comparative risk perceptions have been measured both directly (i.e. a single question requiring a self-to-peer comparison) and indirectly (i.e. separate, absolute questions about the self and one's peers), yet no study has examined which measure is more predictive of concern and intentions. Two studies examined this issue in the context of several health risks (e.g. cancer, heart attacks). Study 1 showed that direct comparisons were generally more predictive of concern and intentions than indirect comparisons. Study 2 replicated this finding and revealed asymmetries in how people responded to absolute self *versus* peer questions. Implications for risk screening in health contexts are discussed.

Keywords: unrealistic optimism; optimistic bias; social comparison; risk perception; indirect and direct methods; behavioural intentions and concern

Introduction

According to various models of health behaviour (e.g. the Health Belief Model, the Precaution Adoption Process Model), perceptions of risk are importantly linked to affective, cognitive and behavioural outcomes (Janz & Becker, 1984; Weinstein, 1988). For instance, a typical finding is that higher risk perceptions are associated with greater worry, more intentions to change one's risky behaviours, and an adoption of preventative behaviours (e.g. Brewer et al., 2007; Klein, 2002). However, the notion that risk perceptions are broadly important is complicated by the fact that there are many types of risk perceptions that a researcher can assess. Much of the past research on this topic has focused on absolute risk perceptions: that is, either verbal (very unlikely) or numerical (20% likely) assessments of the chance that one will experience a particular health event. However, recent research has examined the import of comparative risk perceptions. Importantly, many studies have shown that respondents' perceptions of how their own risk compares to that of other people predict unique variance in concern, intentions and behaviours, above and beyond absolute self risk perceptions (e.g. Blalock, DeVellis, Afifi, & Sandler, 1990; Klein, 2002; Lipkus, Lyna, & Rimer, 2000). Although it is clear that perceptions of social comparative risk can be linked to important outcomes, recent work

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suggests that the method used to measure comparative beliefs may shape the strength of such relationships.

Broadly speaking, there have been two methods used to measure one's perceived comparative status across various dimensions: the direct method and the indirect method (see reviews in Chambers & Windschitl, 2004 and Helweg-Larsen & Shepperd, 2001). First, the *direct method* involves a single question in which a respondent explicitly compares his or her status on some dimension to a specified referent ('Compared to the average person, how likely is it that you will develop cancer?'). Second, the *indirect method* involves separate absolute questions about the self and a specified referent ('How likely is it that you will develop cancer?' and 'How likely is it that the average person will develop cancer?'). A difference score between the absolute self and the referent estimates is considered to be an 'indirect' index of perceived comparative standing. Although these two methods have historically been treated as equivalent, there is emerging evidence that direct and indirect comparative measures (1) are themselves imperfectly correlated (e.g. Aucote & Gold, 2005; Covey & Davies, 2004), (2) differ in the degree to which they are correlated with other variables (e.g. event frequency and severity; see Chambers, Windschitl, & Suls, 2003; Price, Pentecost, & Voth, 2002) and (3) differ in terms of how respondents actually formulate their responses to each measure (e.g. think-aloud procedures have revealed that participants report using different types of information when formulating their responses to direct comparative and absolute judgements; see French & Hevey, 2008) (for reviews, see Chambers & Windschitl, 2004; Helweg-Larsen & Shepperd, 2001; and Otten & Van der Pligt, 1996). Given that basic differences exist between these two measures, it seemed logical that there may also be differences in the degree to which they would be predictive of other variables, such as concern and intentions to reduce one's risk. However, to the author's knowledge, no study has explicitly examined this issue.

The current studies

Overview

The main goal of the current studies was to investigate whether direct or indirect measures of comparative risk are better predictors of concern about one's risk and intentions to reduce it. Across two studies, participants made direct comparative and absolute self and other (i.e. indirect comparative) risk judgements about several health events (e.g. cancer, heart attacks). Additionally, participants indicated how concerned they were about their level of risk for each event and whether they intended to engage in particular behaviours aimed at reducing their risk (e.g. their likelihood of seeking out information about the health risk). In general, it was hypothesised that direct comparisons would be more strongly linked to concern and intentions than indirect comparisons for several, interrelated reasons.

It has been argued that social comparative information is most useful when one's objective standing on some dimension is unknown or ambiguous (Festinger, 1954; Suls & Wheeler, 2000). For example, when determining whether you have strong quantitative skills, your absolute performance on a standardised test may be inadequate, whereas your percentile rank may be quite informative. Likewise, absolute risk information (e.g. '10% chance of Disease X') may be too ambiguous to provide insights about whether one should be concerned and engage in behaviours to reduce the risk. However, knowing whether one's risk level is above or below the average provides a useful reference point with which to evaluate one's own risk and potentially motivate concern or

intentions (Klein, 1997, 2003). If it can be assumed that concern and intentions are shaped more by comparative information/perceptions than absolute information/perceptions, then using a measure that explicitly asks about comparative beliefs should be most useful in predicting concern and intentions.[1] Thus, direct (as opposed to indirect) measures may have the most predictive utility for a couple reasons. First, think-aloud procedures have shown that when answering questions about their comparative standing on various dimensions (e.g. attitudes about religion), participants mention information about other people (i.e. comparative others) significantly more than when answering questions about their absolute standing (Olson, Goffin, & Haynes, 2007). This is perhaps unsurprising, but it suggests that direct measures do indeed elicit more comparison-related information than absolute measures, and are perhaps better at tapping into underlying beliefs or representations that are the most relevant to concern, intentions and behaviours. Second, participants are actually asked to make an explicit comparison with the direct method, and ostensibly do so both internally (i.e. *thinking* about aspects of their comparative status) and externally (i.e. *responding* with a comparative evaluation on a questionnaire).[2] Contrariwise, with the indirect method, participants are asked to make *separate* absolute evaluations for the self and a specified referent (which are only later compared by the researcher); participants are not asked to compare these two responses, nor are they asked to use social comparative information when formulating their responses to absolute questions. Thus, if it is assumed that a participant's feelings of concern and intentions are most shaped by their perceptions of social comparative standing, then measures that are more explicitly 'comparative' and more apt to bring information about others to mind (i.e. direct measures) may hold more utility.

In addition to the above reasons, there are also potential problems in how respondents answer absolute questions that could influence the utility of indirect comparisons. For instance, it has been argued that absolute verbal measures are vague (e.g. 'very likely') and subject to context effects (Moore, 2007), which may end up creating 'noisy' indirect measures. Additionally, there are asymmetries in how people actually formulate their responses to self- *versus* other-risk questions. For instance, some research suggests that people formulate responses to self-risks in a singular mode (e.g. focusing on their own behaviours or characteristics that influence their risks), whereas they formulate responses to other risks in a distributional mode (e.g. focusing on prevalence or frequency information) (Klar, Medding, & Sarel, 1996). Further, think-aloud protocols have also shown that respondents mention more reasons as to why other people may be at high risk (e.g. 'Lack of knowledge', 'Being stupid') and uncertainty (e.g. 'I don't know') when answering other-risk questions than when answering self-risk questions (French & Hevey, 2008). Given that participants might be less certain about estimates of others and more focused on risk-increasing (as opposed to risk-decreasing) behaviours, there may be group tendencies to respond in crude ways, such as generally inflating risk estimates for large referent groups (e.g. Price, Smith, & Lench, 2006) or using restricted portions of the response scale (see, e.g., Gurmankin, Helweg-Larsen, Armstrong, Kimmel, & Volpp, 2005; Moore, 2007; Schwarz, 1999). Overall, then, there may be systematic response biases in absolute other estimates that end up influencing statistical properties of indirectly calculated comparisons (e.g. skewness or range restriction) and their potential predictive utility for concern and intentions. Direct measures may not suffer from such issues because they have more straightforward anchors that disambiguate the response scale and facilitate ease of responding across participants (French & Hevey, 2008; Klar & Ayal, 2004).

Study 1

In Study 1, college student participants made direct comparative estimates about how their own risk for heart attacks, cancer and auto accidents compared to the risks of the average student of the same age/gender. Additionally, participants made absolute self and average student risk estimates (i.e. the indirect method) for the same health events. Finally, for each event, participants indicated how concerned they were about their risks and their intentions to reduce their risks (Klein, 2002). As stated previously, the hypothesis was that direct measures of social comparative risk would be more related to concern and intentions than indirect measures.

Method

Participants

The sample consisted of 89 undergraduate students from the University of Iowa who participated in the study as part of a psychology course requirement.

Measures and procedures

Participants were told that the aim of the study was to investigate general perceptions of their own and others' health, and were then asked a series of questions about three health-related events: heart attacks, cancer and auto accidents. All portions of the study were conducted on computers, and the dependent measures occurred in the order they are described below.

First, participants made direct comparative risk estimates for each event on 7-point scales. For example, participants were asked 'Compared to the average University of Iowa student of the same age/sex, how likely is it that you will [have a heart attack] before the age of 50?' ($-3 =$ *much less likely than the average student*; $0 =$ *as likely as the average student*; $+3 =$ *much more likely than the average student*). This format was repeated for cancer and auto accident risk, and the order of event presentation was randomised.

Next, participants made separate absolute risk estimates for the self and the average University of Iowa student of the same age/sex on 7-point scales. (The order in which participants made self and other estimates was counterbalanced, although this factor did not influence the main findings). Specifically, participants were asked 'How likely is it that you will [have a heart attack] before the age of 50?' and 'How likely is it that the average University of Iowa student of the same age/sex will [have a heart attack] before the age of 50?' ($1 =$ *extremely unlikely*; $7 =$ *extremely likely*). This same format was used for cancer and auto accident risk, and the order of presentation for these events was randomised. These responses were used to calculate indirect comparisons.

Finally, participants were asked about their concern and behavioural intentions related to their risk (derived from Klein, 2002). First, in terms of concern, participants rated how worried, satisfied (reverse-coded) and disturbed they were about their risk level for each event on 7-point scales ($1 =$ *not at all*; $7 =$ *extremely*). Responses to these items were averaged to create an overall 'concern composite' for each event (αs ranged from 0.74 to 0.79; mean $\alpha = 0.77$). Second, in terms of their behavioural intentions, participants were asked two questions. Participants were first asked how likely they were to change their lifestyle to reduce their risk level for each event ($1 =$ *not at all likely*; $7 =$ *extremely likely*). Participants were next asked how likely they were to seek out information about each risk ($1 =$ *not at all likely*; $7 =$ *extremely likely*). Responses to these items were averaged to create

an overall 'behavioural intention composite' for each event (αs ranged from 0.56 to 0.68; mean $\alpha = 0.61$).

Results and discussion

Direct and indirect comparative estimates

First, recall that direct comparisons were made on 7-point scales ($-3 =$ *much less likely than the average student*; $+3 =$ *much more likely than the average student*). When comparing participants' mean responses on these measures to the midpoint (0), the results revealed that participants were (at the group level) comparatively optimistic about their risk for a heart attack and comparatively pessimistic about their risk for an auto accident ($ts > |2.00|, ps < 0.05$), but neither optimistic nor pessimistic about their cancer risk ($t = 0.07, p > 0.10$; see Table 1 for means and SDs). Second, recall that absolute self- and other-risk estimates were made on 7-point scales ($1 =$ *very unlikely*; $7 =$ *very likely*). The means for each event are displayed in Table 1. Indirect comparison measures were calculated by subtracting the absolute other estimates from the absolute self estimates for each event. When comparing the resulting means for each event to '0', participants (at the group level) appeared comparatively optimistic about their risks for heart attacks, cancer and auto accidents ($ts > -2.80, ps < 0.01$; see Table 1 for means and SDs). Importantly, there was evidence of divergence in direct and indirect comparative measures. As shown above, indirect comparisons consistently revealed comparative optimism (at the group level), whereas direct comparisons revealed a mix of optimism, pessimism and neutrality (Table 1). Further, the correlations between direct and indirect comparisons for each event, while high, were not perfect. Specifically, the *r*s (87) between direct and indirect comparisons were 0.52 for heart attack, 0.56 for cancer and 0.52 for auto accident (all $ps < 0.01$), or 0.53 when averaging the *r*s across the three events.

Beyond the overall mean differences in the patterns of direct and indirect comparative optimism, it is also important to consider differences in the *distribution* of responses.

Table 1. Mean estimates of risk, concern and behavioural intentions in Study 1 ($N = 89$).

Event	Direct comparison	Indirect comparison	Absolute self	Absolute other	Concern	Behavioural Intentions
Heart attack	−0.33*	−0.89**	3.52	4.41	4.07	3.88
	(1.53)	(1.53)	(1.57)	(1.09)	(1.51)	(1.71)
Cancer	0.01	−0.46**	3.91	4.37	4.72	4.17
	(1.47)	(1.45)	(1.63)	(1.20)	(1.49)	(1.34)
Auto accident	0.47**	−0.47**	4.75	5.22	4.41	3.28
	(1.27)	(1.59)	(1.47)	(1.12)	(1.42)	(1.43)

Notes: SDs appear below means in parentheses. Direct comparative estimates were made on 7-point scales ($-3 =$ *much less likely than average*; $+3 =$ *much more likely than average*). Absolute risk estimates were made on 7-point scales ($1 =$ *very unlikely*; $7 =$ *very likely*). Means in the 'indirect comparison' column were created by subtracting absolute other estimates from absolute self estimates for each event. Values in the direct and indirect comparison columns that significantly differ from '0' are marked with asterisks (*$p < 0.05$; **$p < 0.01$). The 'concern' and 'behavioural intention' composites are means created from responses made on 7-point scales (lower values indicate less concern about, and lower intentions to reduce one's risk).

For instance, as expected, participants tended to use a more restricted range of the likelihood scale when answering absolute other questions than absolute self questions. One indication of this was that the variability in the responses to absolute other questions was lower than the variability in the responses to absolute self questions (all $Fs > 7, ps < 0.01$; see Table 1 for SDs). Additionally, the proportion of responses that used the moderate-to-high end of the scale (i.e. responses of four or greater on the 1–7 likelihood scale) was higher for absolute other questions (86% of all responses were four or greater) than absolute self questions (65% of all responses were four or greater, suggesting more balanced responding), $\chi^2\,(1, N = 534) = 32.86$, $p < 0.01$. Further, this result is indicative of the fact that indirect comparative estimates were somewhat more skewed than direct comparative estimates (overall skewness indices were -0.51 and -0.15 for indirect and direct comparative estimates, respectively; skewness values that are closer to '0' indicate more normal distributions) and that indirect comparative estimates tended to cluster more than direct comparative estimates (overall kurtosis indices were 0.82 and -0.62 for indirect and direct comparative estimates, respectively; positive kurtosis values indicate more clustering around a central point, negative values indicate less clustering/flatter distributions, and a value of '0' indicates a normal distribution). Although the overall variability between direct and indirect comparative measures did not differ (all $Fs < 2, ps > 0.10$; see Table 1 for SDs), the aforementioned differences in the distribution of indirect and direct comparative estimates are at least suggestive of the possibility that there may be underlying statistical issues that could impact their relative utility to predict concern and intentions. This correspondence between comparative estimates and concern/intentions is explored in the next two sections.

Relationship between direct/indirect comparisons and concern

Zero-order correlations were computed separately for each event using the direct and indirect comparison values and the 'concern composites' (see Table 1 for means). These analyses revealed that both direct and indirect comparisons were significantly associated with concern for each event, where greater perceptions of comparative risk were associated with more concern about one's risk ($rs > 0.45$ for direct, $rs > 0.28$ for indirect; see Table 2 for all correlations). As expected, however, a cursory examination of these correlations revealed that direct comparisons tended to be more robustly related to concern than were indirect comparisons. A series of multiple linear regression analyses were conducted to more directly test this notion. Specifically, a regression analysis was conducted across participants for each event, where the direct and indirect comparative estimates were

Table 2. Zero-order correlations between direct/indirect comparisons, concern and behavioural intentions in Study 1 ($N = 89$).

	Direct comparison		Indirect comparison	
Event	Concern	Behavioural intentions	Concern	Behavioural intentions
Heart attack	0.57**	0.34**	0.28**	0.25*
Cancer	0.56**	0.33**	0.33**	0.23*
Auto accident	0.45**	0.31**	0.31**	0.30**

Notes: *$p < 0.05$; **$p < 0.01$.

entered simultaneously as predictors of concern (i.e. the concern composite calculated for each event). The results showed that direct comparative estimates consistently accounted for more variance in concern, above and beyond indirect comparative estimates. This was the case for heart attack risk (direct $\beta = 0.59$, SE $= 0.11$, $t(88) = 5.58$, $p < 0.05$; indirect $\beta = -0.04$, SE $= 0.11$, $t(88) = -0.36$, $p > 0.10$), cancer risk (direct $\beta = 0.56$, SE $= 0.11$, $t(88) = 5.24$, $p < 0.05$; indirect $\beta = -0.001$, SE $= 0.11$, $t(88) = -0.01$, $p > 0.10$) and auto accident risk (direct $\beta = 0.35$, SE $= 0.12$, $t(88) = 3.13$, $p < 0.05$; indirect $\beta = 0.21$, SE $= 0.10$, $t(88) = 1.87$, $p > 0.05$).

Relationship between direct/indirect comparisons and behavioural intentions

Zero-order correlations were computed separately for each event using the direct and indirect comparison values and the 'behavioural intention composites' (see Table 1 for means). These analyses revealed that both direct and indirect comparisons were significantly predictive of intentions, where greater perceptions of comparative risk were associated with more intentions aimed at reducing the risk ($rs > 0.31$ for direct, $rs > 0.23$ for indirect; see Table 2 for all correlations). As with concern, a cursory examination of these correlations revealed that direct comparisons were somewhat more strongly correlated with intentions than indirect comparisons. Indeed, multiple linear regression analyses (conducted in an identical fashion as described above with concern, but using the behavioural intention indices as criterion variables) generally revealed that direct comparative estimates accounted for more variance in behavioural intentions, above and beyond indirect comparative estimates. This pattern was supported for heart attack risk (direct $\beta = 0.28$, SE $= 0.14$, $t(88) = 2.35$, $p < 0.05$; indirect $\beta = 0.10$, SE $= 0.14$, $t(88) = 0.82$, $p > 0.10$) and cancer risk (direct $\beta = 0.29$, SE $= 0.14$, $t(88) = 2.34$, $p < 0.05$; indirect $\beta = 0.07$, SE $= 0.14$, $t(88) = 0.55$, $p > 0.10$), but only partially supported for auto accident risk (direct $\beta = 0.20$, SE $= 0.14$, $t(88) = 1.73$, $p = 0.08$; indirect $\beta = 0.19$, SE $= 0.11$, $t(88) = 1.67$, $p = 0.10$). [3]

Study 2

The results of Study 1 showed that direct and indirect comparisons were imperfectly related to one another and differentially predictive of concern and behavioural intentions (Table 2). Study 2 was conducted as a replication and extension of Study 1. The materials and procedure were essentially the same, with the following exceptions. First, two health events (HIV/AIDS and high blood pressure) were added to the procedures in order to generalise the findings to new events. Second, it was important to rule out the possibility that the results in Study 1 were due to the order in which participants answered the three risk questions (direct comparative questions were always answered first). Thus, participants in Study 2 responded to the risk questions in counterbalanced orders. Finally, Study 2 also examined some potential asymmetries in how people respond to direct comparative, absolute self, and absolute other questions, with particular interest in comparing asymmetries in the absolute measures. Specifically, Study 2 examined response times, how confident participants were in their risk estimates, and the extent to which participants reported using prevalence information (i.e. statistics) when formulating their risk estimates. As indicated in the introduction, such asymmetries or characteristics of the absolute estimates may be suggestive of problems underlying the use of indirect calculations based on such measures.

Method

Participants

The sample consisted of 98 undergraduate students from the University of Iowa who participated in the study as part of a psychology course requirement.

Measures and procedures

In general, the procedures in Study 2 were comparable to Study 1. As in Study 1, participants made the following judgements about each of the five events: (1) direct comparative likelihood estimate (2) absolute self likelihood estimate, (3) absolute other likelihood estimate, (4) three concern items (αs ranged from 0.75 to 0.84; mean $\alpha = 0.79$) and (5) two behavioural intention items (αs ranged from 0.62 to 0.71; mean $\alpha = 0.67$). The only changes made from Study 1 to Study 2 regarding this phase of the study were that two events were added to the procedures (HIV/AIDS and high blood pressure), and the order in which participants responded to the three risk question types was counterbalanced. With regards to the counterbalancing, participants either answered the direct or the indirect (absolute self and other) questions first. Additionally, the order in which participants answered the self- and other-risk questions was counterbalanced. Thus, participants were randomly assigned to one of four question orders.

Several supplemental measures were also added to Study 2. First, the computer recorded the amount of time (in seconds) it took for participants to respond to each risk question. To account for the fact that there were differences in question word length, the appearance of the response scale was delayed for several seconds after the question was already on the screen. Thus, the computer started recording when the scale (not the question) appeared and stopped recording after a participant made a response to exit (see also, Aucote & Gold, 2005). Second, after participants answered all of the main dependent measures, they were prompted to think back on their risk estimates. For each of the three risk question types (and for every event), participants estimated (1) how confident they were in their previous responses (1 = *not at all confident*; 5 = *completely confident*) and (2) the extent to which they used statistics or numbers when formulating each of their previous responses (1 = *not at all*; 5 = *completely*). Thus, participants made two judgements each (confidence estimate, statistical estimate) about their previous responses to all 15 risk questions.[4]

Results and discussion

The order of the risk questions did not impact the mean responses across the main dependent measures (all Fs $< 2, p$s > 0.15), which suggests the results in Study 1 were not simply due to the order in which risk questions were answered. All analyses presented below collapse across this order variable (except where noted).

Direct and indirect comparative estimates

First, when comparing participants' mean responses on the direct comparison measures to the midpoint (0), the results revealed that participants were (at the group level) comparatively optimistic about their risk for heart attacks, cancer, HIV/AIDS and high blood pressure (ts $> |2.00|, p$s < 0.05). However, participants were neither optimistic nor

pessimistic about their risk for an auto accident ($t = 0.08, p > 0.10$; see Table 3 for means and SDs). Second, after calculating indirect comparisons (absolute self estimates – absolute other estimates) for each event and comparing these mean values to '0', the results revealed that participants were (at the group level) comparatively optimistic about their risk for all events ($ts > -6.00, ps < 0.01$; see Table 3 for means and SDs). Further, as in Study 1, the correlations between direct and indirect measures, while high, were not perfect. Specifically, the *r*s (96) between direct and indirect comparisons were 0.37 for heart attacks, 0.41 for cancer, 0.33 for auto accidents, 0.33 for HIV/AIDS, and 0.63 for high blood pressure (all $ps < 0.05$), or 0.41 when averaging these *r*s across all five events.

In addition to overall mean differences in the patterns of direct and indirect comparisons, there was some evidence (albeit less strong than Study 1) of distributional differences. For instance, participants again tended to use a more restricted range of the likelihood scale when answering absolute other questions than when answering absolute self questions. More specifically, the variability in the responses to absolute other questions was generally lower than the variability in the responses to absolute self questions ($Fs > 3.50, ps < 0.05$, except for cancer and HIV/AIDS; see Table 3 for SDs). Also, the proportion of responses using the moderate-to-high end of the scale (i.e. responses of four or greater on the 1–7 likelihood scale) was higher for absolute other questions (74% of all responses were four or greater) than absolute self questions (41% of all responses were four or greater, suggesting more balanced responding), $\chi^2 (1, N = 980) = 108.48$, $p < 0.01$. Thus, as indicated by these proportions, indirect comparative estimates (as compared to direct comparative estimates) tended to (1) be skewed in an optimistic direction (overall skewness indices were −0.35 and 0.32 for indirect and direct comparisons, respectively) and (2) show more evidence of clustering (overall kurtosis estimates were 0.28 and −0.46 for indirect and direct comparative estimates, respectively; again, positive values indicate more clustering). Again, although the overall variability between direct and indirect comparative measures only differed for

Table 3. Mean estimates of risk, concern and behavioural intentions in Study 2 ($N = 98$).

Event	Direct comparison	Indirect comparison	Absolute self	Absolute other	Concern	Behavioural intentions
Heart attack	−1.01**	−1.15**	2.79	3.94	3.84	4.12
	(1.23)	(1.48)	(1.44)	(1.28)	(1.26)	(1.49)
Cancer	−0.38**	−0.93**	3.37	4.30	4.77	4.32
	(1.26)	(1.51)	(1.44)	(1.29)	(1.38)	(1.57)
Auto accident	0.01	−0.85**	4.84	5.69	4.32	3.35
	(1.20)	(1.25)	(1.53)	(1.18)	(1.35)	(1.48)
HIV/AIDS	−2.14**	−2.09**	1.55	3.64	2.67	3.65
	(1.21)	(1.63)	(1.06)	(1.39)	(1.45)	(1.83)
High blood pressure	−0.32*	−0.98**	3.57	4.55	3.73	3.95
	(1.39)	(1.61)	(1.64)	(1.16)	(1.33)	(1.48)

Notes: SDs appear below means in parentheses. Direct comparative estimates were made on 7-point scales (−3 = *much less likely than average*; +3 = *much more likely than average*). Absolute risk estimates were made on 7-point scales (1 = *very unlikely*; 7 = *very likely*). Means in the 'indirect comparison' column were created by subtracting absolute other estimates from absolute self estimates for each event. Values in the direct and indirect comparison columns that significantly differ from '0' are marked with asterisks (*$p < 0.05$; **$p < 0.01$). The 'concern' and 'behavioural intention' composites are means created from responses made on 7-point scales (lower values indicate less concern about, and lower intentions to reduce one's risk).

two of the five events ($Fs > 4, ps < 0.01$ for heart attack and HIV/AIDS, all other $Fs < 2, ps > 0.10$; see Table 3 for SDs), some of these other differences in the underlying distribution may be important for understanding divergence in the correspondence between direct/indirect comparisons and concern/intentions.

Relationship between direct/indirect comparisons and concern

Zero-order correlations revealed that direct comparisons were significantly predictive of concern (see Table 3 for 'concern composite' means) for all events ($rs > 0.28, ps < 0.01$). However, indirect comparisons were only significantly predictive of concern for heart attack, HIV/AIDS, and high blood pressure risk ($rs > 0.20, ps < 0.05$); the correlations for cancer and auto accident risk were less robust ($rs < 0.10, ps > 0.10$; see Table 4 for all rs). Additionally, multiple linear regression analyses (conducted identically to Study 1) generally showed that direct comparative estimates accounted for more variance in concern, above and beyond indirect comparative estimates. This pattern was supported for heart attack risk (direct $\beta = 0.36$, SE $= 0.10$, $t(97) = 3.60$, $p < 0.05$; indirect $\beta = 0.12$, SE $= 0.09$, $t(97) = 1.20$, $p > 0.10$), cancer risk (direct $\beta = 0.49$, SE $= 0.10$, $t(97) = 4.94$, $p < 0.05$; indirect $\beta = -0.13$, SE $= 0.09$, $t(97) = 0.20$, $p > 0.10$), auto accident risk (direct $\beta = 0.28$, SE $= 0.12$, $t(97) = 2.70$, $p < 0.05$; indirect $\beta = -0.004$, SE $= 0.11$, $t(97) = -0.04$, $p > 0.10$) and HIV/AIDS risk (direct $\beta = 0.38$, SE $= 0.12$, $t(97) = 3.81$, $p < 0.05$; indirect $\beta = 0.08$, SE $= 0.09$, $t(97) = 0.79$, $p > 0.10$), but only partially supported for high blood pressure risk (direct $\beta = 0.28$, SE $= 0.11$, $t(97) = 2.53$, $p < 0.05$; indirect $\beta = 0.33$, SE $= 0.09$, $t(97) = 2.94$, $p < 0.05$).

Relationship between direct/indirect comparisons and behavioural intentions

Zero-order correlations revealed that direct comparisons were significantly predictive of behavioural intentions (see Table 3 for 'behavioural intention composite' means) for heart attack, HIV/AIDS and high blood pressure risk ($rs > 0.22$, $ps < 0.05$); however, the correlations for cancer and auto accident risk were less robust ($rs < 0.16, ps > 0.10$). Indirect comparisons were significantly predictive of intentions for high blood pressure risk ($r = 0.24$, $p < 0.05$); however, the correlations for heart attack, cancer, auto accident and HIV/AIDS risk were less robust ($rs < |0.04|$, $ps > 0.10$; see Table 4 for all rs). Additionally, multiple linear regression analyses (conducted identically to Study 1) generally showed that

Table 4. Zero-order correlations between direct/indirect comparisons, concern, and behavioural intentions in Study 2 ($N = 98$).

	Direct comparison		Indirect comparison	
Event	Concern	Behavioural intentions	Concern	Behavioural intentions
Heart attack	0.41**	0.23*	0.25*	−0.02
Cancer	0.44**	0.16	0.07	−0.02
Auto accident	0.28**	0.06	0.09	0.00
HIV/AIDS	0.40**	0.22*	0.20*	0.04
High blood pressure	0.48**	0.36**	0.50**	0.24**

Notes: *$p < 0.05$; **$p < 0.01$.

direct comparative estimates accounted for more variance in behavioural intentions, above and beyond indirect comparative estimates. Generally speaking, this was the case for heart attack risk (direct $\beta = 0.27, SE = 0.13, t(97) = 2.51, p < 0.05$; indirect $\beta = -0.12$, $SE = 0.11$, $t(97) = -1.08$, $p > 0.10$), cancer risk (direct $\beta = 0.20, SE = 0.14, t(97) = 1.84$, $p = 0.06$; indirect $\beta = -0.10$, $SE = 0.12$, $t(97) = 0.36$, $p > 0.10$), HIV/AIDS risk (direct $\beta = 0.25$, $SE = 0.16, t(97) = 2.36, p < 0.05$; indirect $\beta = -0.10$, $SE = 0.12$, $t(97) = -0.93$, $p > 0.10$) and high blood pressure risk (direct $\beta = 0.34, SE = 0.13, t(97) = 2.81, p < 0.05$; indirect $\beta = 0.03$, $SE = 0.11$, $t(97) = 0.24$, $p > 0.10$), but this pattern was not supported for auto accident risk (direct $\beta = 0.06, SE = 0.16, t(97) = 0.57$, $p > 0.10$; indirect $\beta = -0.02$, $SE = 0.13$, $t(97) = -0.15, p > 0.10$).[5]

Response times

Recall that the time it took for participants to respond to each of the risk questions (in seconds) was recorded. Given that the response time data was skewed, square-root transformations were conducted (see Aucote & Gold, 2005, for a similar treatment of such data). These transformed values were then averaged across events to form a single mean for direct comparisons, a single mean for absolute self estimates, and a single mean for absolute other estimates (all αs > 0.67), and were then submitted to a 3 (question type: direct, absolute self, absolute other) $\times$ 4 (order) mixed ANOVA. Although a main effect of question type was indeed found, $F(2, 93) = 77.75, p < 0.01$, a significant question type $\times$ order interaction was also present, $F(1, 188) = 24.18$, $p < 0.01$. Therefore, to eliminate the effect of order, the analysis was restricted to only the responses to a particular type of question (e.g. comparative) that came *first* in the procedures. Table 5 presents the means and SDs used in this analysis. When submitting these means to a one-way ANOVA, a significant effect of question type was found, $F(2, 95) = 27.87, p < 0.01$. Follow-up tests revealed that response times for direct comparative estimates ($M = 0.74, SD = 0.17$) were longer than response times for absolute self estimates ($M = 0.44, SD = 0.18$), $t(73) = 7.11$, $p < 0.01$, but not significantly different from response times for absolute other estimates ($M = 0.68$, $SD = 0.13$), $t(71) = 1.41$, $p > 0.10$. More importantly, the response times for absolute self estimates were shorter than the response times for absolute other estimates, $t(46) = -5.45$, $p < 0.01$. This suggests that it may have been more difficult for participants to formulate a response about the average person's risk.

Table 5. Supplementary measures in Study 2.

	Direct comparison		Absolute self		Absolute other		Self *vs.* other	
	M	SD	*M*	SD	*M*	SD	*t*	*p*
Response time	0.74	0.17	0.44	0.18	0.68	0.13	−5.45	<0.05
Confidence estimate	3.46	0.74	3.52	0.74	3.38	0.73	1.87	=0.06
Statistical estimate	2.73	0.96	2.72	0.96	2.91	0.97	−2.56	<0.05

Notes: Values in the table average across events for each question type (i.e. direct, absolute self and absolute other). Means in the 'Response time' row are the log-transformed time that it took for participants to respond to each question. For the 'Confidence estimate' row, participants estimated how confident they were in the responses they gave for each question (1 = *not at all confident*; 5 = *completely confident*). For the 'Statistical estimate' row, participants estimated the extent to which they used numbers or statistics when answering each question (1 = *not at all*; 5 = *completely*).

Confidence estimates

Recall that participants judged how confident they were about their responses to each of the previous risk questions (1 = *not at all confident*; 5 = *completely confident*). After collapsing across events (all αs > 0.75) to form a mean for each of the three question types (Table 5), a one-way ANOVA on the resulting means did not reveal a significant overall effect of question type, $F(2, 96) = 1.74$, $p > 0.10$. Nevertheless, there was *a priori* interest in comparing absolute self and other estimates. This analysis revealed a trend for absolute other estimates to be held with less confidence overall ($M = 3.38$, SD = 0.73) than absolute self estimates ($M = 3.52$, SD = 0.74), $t(97) = 1.87$, $p = 0.06$.

Statistical estimates

Finally, participants also estimated the extent to which they used 'statistics or numbers' when responding to the previous risk questions (1 = *not at all*; 5 = *completely*). After averaging across events (all αs > 0.83) for the three risk question types (Table 5), a one-way ANOVA on the resulting means revealed an overall significant effect of question type, $F(2, 96) = 4.61$, $p < 0.05$. In general, the statistical estimates for the comparative ($M = 2.73$, SD = 0.96) and absolute self ($M = 2.72$, SD = 0.96) questions did not differ from one another ($t(97) = 0.15$, $p > 0.10$), but they both differed from the statistical estimates for the average other questions ($M = 2.91$, SD = 0.97; ts > 2.50, ps < 0.05). Specifically, participants indicated using statistics or numbers more in their responses to the absolute other questions than in their responses to either direct comparative or absolute self questions.

General discussion

The current studies provide further evidence that direct and indirect perceptions of comparative risk should not simply be viewed as different ways of measuring the same underlying construct. For instance, direct and indirect risk comparisons themselves were not perfectly correlated, and the magnitude (and sometimes direction) of comparative bias at the group level was divergent for some of the events (Tables 1 and 3). Additionally (and perhaps consequently), direct comparisons tended to be more related to concern about one's risk and to intentions to reduce one's risk than indirect comparisons (Tables 2 and 4). Finally, Study 2 also showed that there may be asymmetries in how people answer different types of risk questions. For instance, participants took longer to answer direct comparative and absolute other questions than absolute self questions, were more likely to report using statistics or numbers when answering absolute other questions, and were marginally less confident in their responses to absolute other questions than absolute self questions (Table 5).

Why are direct comparisons better predictors of concern and intentions?

As stated previously, there may be several explanations as to why direct comparisons are more related to concern and intentions than indirect comparisons.

First, perhaps concern and intentions to reduce risks are, more often than not, shaped by comparative (as opposed to absolute) risk information/perceptions, and direct measures are simply more effective in picking up on such beliefs or underlying representations. Think-aloud studies have revealed that participants mention others

more when answering comparative (as opposed to absolute) questions, suggesting that direct measures explicitly bring comparative reference points to mind that may be critical for shaping levels of concern and intentions (Olson et al, 2007). Also, with direct measures, the participants themselves are asked to psychologically consider their comparative standing and respond accordingly on a questionnaire. However, with absolute measures (i.e. the indirect method), participants are not asked to make comparisons or to use comparative reference points when answering the two absolute questions. In this case, the 'difference' in these absolute evaluations (i.e. the indirect measures calculated by the researcher) may not reflect any meaningful, underlying psychological comparison or representation of risk that participants make or even possess.

Second, there are also potential problems with absolute estimates that may reduce the predictive utility of indirect comparisons calculated from such estimates. For instance, absolute estimates made on verbal scales may be problematic because they are vague and contextually dependent (e.g. Moore, 2007; Schwarz, 1999). Thus, participants might have different interpretations of the words 'likely' or 'unlikely', engendering noisy responses to absolute measures (and thus indirect comparison measures). Furthermore, issues related to the ways in which respondents answer absolute other (as opposed to absolute self) questions may be problematic for indirectly calculated comparisons. As shown in the current study and elsewhere, there are asymmetries in how people respond to absolute self *versus* absolute other questions. For instance, in addition to relying more on prevalence information and risk-increasing (as opposed to risk-decreasing) factors when making absolute other estimates (French & Hevey, 2008), participants report being somewhat less confident, more uncertain and take more time to answer absolute other questions than absolute self questions (Table 5; see also Aucote & Gold, 2005; French & Hevey, 2008). Thus, because other estimates may be more 'difficult' to make, participants end up formulating their responses in crude ways, such as generally inflating estimates about others or only using a restricted portion of the response scale (particularly the moderate-to-high risk portions). Indeed, in Studies 1 and 2, participants tended to use the moderate-to-high portion of the likelihood scale when answering absolute other questions, but were more balanced when answering absolute self questions. This also meant that absolute other risk estimates tended to be generally less variable and more inflated than absolute self estimates (Tables 1 and 3). Further, when calculating indirect comparative estimates from such responses, the underlying distribution (as compared to the distribution in direct comparative estimates) was somewhat more skewed towards optimistic responses and revealed evidence of clustering in the responses (i.e. a tighter distribution where values clustered around central points). Although the actual variability generally did not differ between direct and indirect comparative estimates, the fact that indirect comparisons had relatively unusual distributional properties could have adversely impacted their ability to predict concern and intentions (e.g. from the creation of range restriction in indirect measures).

Implications for risk screening

The current set of findings may be informative for determining what types of risk perceptions to screen for in health settings. Although there was clear evidence that direct measures were generally more predictive of concern and intentions than indirect measures, some researchers have questioned the validity of direct measures because

of their conflation with self estimates and the apparent lack of 'comparison' taking place (e.g. Gold, 2007; Klar & Giladi, 1999). Further, given this purported high conflation of direct comparative and self estimates, some researchers have recommended that indirect measures be used *in lieu* of what have been viewed as 'biased' direct measures (Aucote & Gold, 2005; Covey & Davies, 2004). Although it is the case that absolute self and direct comparative estimates are often highly correlated, some research has shown that direct comparative estimates and absolute self estimates are uniquely predictive of concern and intentions (e.g. Zajac, Klein, & McCaul, 2006). In the current study, there was support for both of these notions. First, it was the case that absolute self and direct comparative estimates were highly correlated in both studies (all rs > 0.54, ps < 0.01). Second, when averaging partial correlations computed for each event across Studies 1 and 2 (after r-to-z transformation), direct comparisons still seemed to show some relation with concern and intentions even when controlling for absolute self estimates (mean partial r with concern $= 0.17$, SD $= 0.09$, $t(7) = 5.11$, $p < 0.01$; mean partial r with intentions $= 0.08$, SD $= 0.08$, $t(7) = 2.90$, $p < 0.05$). The reverse was also true: absolute self estimates still predicted concern and intentions after controlling for direct comparisons (mean partial rs > 0.13, ts > 3, ps < 0.05). However, it is clear from the previously reported regression analyses that indirect comparative estimates account for little variance in concern and intentions when controlling for the effects of direct comparative estimates. Given this set of findings, the cautionary recommendations against using direct comparative measures seem unwarranted. Instead, if the goal of the researcher is to predict concern, intentions and potentially behaviours, it may be recommended that both direct comparative and absolute self estimates (but not necessarily indirect comparative estimates) be measured in risk screenings.

However, before making too firm of a recommendation towards using direct (as opposed to indirect) comparative measures, there are several additional issues to consider. First, there may actually be times when it is preferable to use indirect (as opposed to direct) comparison measures. For example, Helweg-Larsen and Shepperd (2001) point out that one advantage of indirect methods is that they permit an investigation into whether particular moderators of comparative optimism (e.g. mood, locus of control) influence *self*-risk estimates or *other*-risk estimates. Direct measures do not permit such analyses because it is unclear whether respondents are inflating other estimates or deflating self estimates when showing patterns of comparative optimism. In short, there may be *a priori* justifications for using either direct or indirect measures and the choice may depend on the goals of the researcher (see Helweg-Larsen & Shepperd, 2001, for further discussion of this issue).

Second, before determining whether direct or indirect measures of comparative risk are more valuable for predicting health outcomes, it is vital to examine these relationships using a prospective design. Although measuring risk perceptions and other variables in a cross-sectional design can be useful for investigating some (albeit limited) issues (e.g. Do individuals reporting the highest risk also have more intentions to reduce their risk?), it does not permit an examination of causal links, nor does it permit a test of behavioural motivation or risk-reappraisal hypotheses (e.g. Do risk perceptions at one time point influence behavioural change by a later time point; e.g. Brewer, Weinstein, Cuite, & Herrington, 2004; Weinstein & Nicolich, 1993). For instance, one shortcoming of the current work is that it is impossible to know whether risk perceptions influence concern (and intentions) or whether concern (and intentions) influence risk perceptions (Lipkus, Klein, Skinner, & Rimer, 2005; Loewenstein, Weber, Hsee, & Welch, 2001). In short,

future investigations using prospective designs would be useful for clearing up issues related to causality and for testing other aspects of the risk perception/behaviour relationship.

Third, there may be cases when social comparative information or perceptions have little utility beyond absolute information or perceptions. For instance, when information about objective (or absolute) standing is known and unambiguous, social comparative standing may be unnecessary or superfluous in influencing self-perceptions or other outcomes (Moore & Klein, in press). For example, if one's absolute risk for Disease X is extremely high, this information alone (i.e. absent from a comparative context) may be sufficient to motivate concern, intentions or preventative behaviours (Klein, 2003). In short, there may be cases when comparative information is more useful than absolute information, and vice versa. Future work that more explicitly identifies such cases would be useful.

Conclusions

In 2007, Gold stated that 'the practical significance of UO [unrealistic optimism]-be they directly or indirectly measured-remains to be established' (p. 245). This research can be viewed as a step towards informing researchers and health professionals about the implications of measuring comparative risk perceptions directly *versus* indirectly. One implication of the current work is that direct comparisons tend to be better predictors than indirect comparisons of important health outcomes (e.g. concern about, and intentions to reduce one's risk). Although it may be best to measure both direct and indirect risk comparisons, a researcher should select the measure that best matches his/her research goals when assessing both is not feasible.

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Notes

1. Although considerable research has suggested that risk perceptions influence concern/worry, the opposite may also be true: concern/worry may impact risk perceptions (Lipkus, Klein, Skinner & Rimer, 2005; Loewenstein, Weber, Hsee & Welch, 2001). As will be described later, the current research utilised a cross-sectional design and it is therefore impossible to distinguish between these different directions of causality in the current studies. However, it is notable that some research has suggested that worry mediates the relationship between risk perception and preventative behaviours (Chapman & Coups, 2006).
2. The language used here implies that there is, in fact, a full and deliberate comparison being made by participants when answering direct comparative questions. Some research has suggested that direct comparative estimates are highly conflated with absolute self estimates and that instead of making a true 'comparison', participants may simply use their absolute self-assessments as a proxy (e.g. Gold, 2007; Klar & Giladi, 1999). Although it is clear that there is substantial overlap between these measures, there is evidence elsewhere to suggest that responses to 'comparative' estimates do involve some consideration of both the self and the referent (Windschitl, Rose, Stalkfleet, & Smith, in press) and that absolute self and direct comparative estimates are not perfectly correlated (Lipkus et al., 2000). Further separating these constructs is evidence that absolute self and direct comparative estimates independently predict health outcomes (Zajac, Klein, & McCaul, 2006).

3. It is important to note that absolute self estimates were also quite predictive of concern and intentions (the average of the *r*s across all events was 0.51 for concern and 0.36 for intentions). However, it is also notable that there was evidence that direct comparative estimates and absolute self estimates were both uniquely predictive of concern and intentions (see also, Klein, 2002; Lipkus et al., 2000; Zajac et al., 2006). These results will be returned to in the 'General discussion'.
4. After participants answered the 'statistical estimate' questions, they were also asked about the extent to which they went with their 'gut' when answering each risk question. This was included because previous research has shown that gut-level estimates are more related to behaviours than numeric-level estimates (see, e.g. Windschitl & Wells, 1996), and it was speculated that direct measures may be answered in a more 'gut-level' fashion. However, there were no significant differences found across the three question types, thus these analyses were not included in the text to save space.
5. As in Study 1, it is important to note that absolute self estimates in Study 2 were also quite predictive of concern and intentions (the average of the *r*s across all events was 0.49 for concern and 0.21 for intentions).

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