What You Should Want From Your Professional: The Impact of Educational Information on Peoples' Attitudes Toward Simple Actuarial Tools

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Abstract

The ability to increase positive attitudes toward the usage of simple actuarial tools by presenting educational information regarding the benefits of such tools (i.e., accurate and efficient) was assessed. Using a 2 (Accuracy Information vs. No Accuracy Information) X 2 (Efficiency Information vs. No Efficiency Information) between-participants design, participants were presented with details of a simple actuarial decision making tool in either a medical scenario (Study 1; *N* = 404) or a legal scenario (Study 2; *N* = 325), and asked to report their attitudes toward the tool. Results from both studies showed that informing people of the benefits of simple actuarial tools led to increases in levels of satisfaction and willingness to adopt the tools, as well as increased ratings regarding the fairness and ethicalness of the tools. The initial acceptance of the tool and relative impact of the type of educational information, however, did differ across the two scenarios. Implications for the implementation of simple actuarial tools in real world decision making contexts are discussed.

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Professionals within a variety of real-world domains must make consequential predictive decisions (e.g., doctors diagnosing patients' medical conditions, psychologists determining patients' likelihood of harming themselves). Given the importance of these types of decisions, and the time and resource constraints present in many decision contexts, the ability of professionals to make accurate and efficient decisions within these settings is vital. Extensive research established that using simple actuarial decision making tools – which use only the information shown to be predictive and combine the information using objective rules – can allow professionals to make quick and accurate decisions (Grove, Zald, Lebow, Snitz, & Nelson, 2000). Despite the utility of simple actuarial tools, however, professionals have been hesitant to rely upon them when making decisions (e.g., Vrieze & Grove, 2009). One potential reason for this hesitancy is the distrust of simple actuarial tools by those affected by the decision outcome (Eastwood, Snook, & Luther, 2012). The purpose of the current study was to assess whether providing people with information regarding the accuracy and efficiency of simple actuarial tools would increase the acceptance of these approaches.

Regardless of the exact situational context, the process of arriving at a decision involves two steps: (1) determining what information to collect and include in the decision calculation and (2) determining the manner in which to combine this information to arrive at a final decision. With regards to the first step, the traditional viewpoint has been that all available information should be collected and included in the decision making process in order to ensure an optimal outcome (see Gigerenzer, Todd, & the ABC Research Group, 1999). However, not all available information in a given decision context is predictive, and therefore accurate decisions can be made by ignoring non-predictive information and basing the decision only on the information that is actually related to the decision outcome (see Dawes, Faust, & Meehl, 1989; Grove et al., 2000). Furthermore, various time and resource constraints under which many real-world decisions are made means that collecting and integrating large amounts of information is often unfeasible (e.g., police officer faced with an armed suspect; see Gigerenzer & Goldstein, 1996).

With regards to the second step in the decision making process, information that is collected can be combined using one of two approaches – in mechanical fashion through the use of systematic decision rules or in human-based fashion through the use of professionals' intuition and experience (Dawes et al., 1989). Over the past eight decades, the superiority of the mechanical, or actuarial, approach in producing accurate prediction decisions has been demonstrated conclusively across a variety of contexts. In an initial review of the area, Meehl (1954) showed that, across 20 studies, actuarial methods either equalled or outperformed human-based methods in terms of prediction accuracy. In a more recent summary of the literature comparing the two approaches on predictive accuracy, Grove et al. (2000) found that of the 136 studies included in their meta-analysis, 63 (46%) favoured mechanical prediction, 65 (48%) showed equal performance, and 8 (6%) favoured human-based prediction. Taken together, extant research suggests that the most accurate and efficient method of making decisions is to use a mechanical approach that includes only the information shown to be predictive (i.e., simple actuarial tools).

In recognition of the potential usefulness of simple actuarial tools, they have been developed and integrated in many real-world contexts – often in the form of computerized decision aids. These tools are created by using statistical techniques to identify the information that is truly predictive – and the relative predictive power of each piece of information – in a given decision context (e.g., Goldman et al., 1996; Quinsey, Harris, Rice, & Cormier, 1998). Such computerized clinical support systems have been created to assist physicians in diagnosing a variety of medical conditions ranging from abdominal pain to acute chest pain (Garg et al., 2005). Similarly, in the psychological domain, a number of simple actuarial risk assessment instruments have been created to assist clinicians in predicting the future behaviour of offenders (e.g., Violence Risk Appraisal Guide, Iterative Classification Tree; Scott & Resnick, 2006). The usage of such tools not only allow professionals to make more accurate decisions (see Garg et al., 2005), but given their automated nature and focus on only predictive information, to make quicker decisions as well (e.g., Bogusevicius, Maleckas, Pundzius, & Skaudickas, 2002). By allowing quicker and more accurate decisions, implementing simple actuarial tools would arguably lead to important practical improvements in many decision contexts (e.g., save resources through reduced inappropriate hospital admissions and parole denials, save lives by increased correct diagnosis of serious medical conditions and identification of truly violent offenders; see Dawes et al., 1989, Wolf, 2014).

Despite the demonstrated efficacy of simple actuarial tools and positive implications of their usage, professionals in many decision making contexts appear hesitant to utilize them. For example, a survey of 183 clinical psychologists revealed that only 31% of respondents reported using a mechanical method to integrate data when making clinical assessment decisions (Vrieze & Grove, 2009). Similarly, a survey of 830 psychologists working within U.S. correctional facilities found that few participants mentioned using actuarial tools when conducting assessments of offender risk (Boothby & Clements, 2000). Within the medical domain, Corey and Merenstein (1987) found that physicians used an actuarial instrument for predicting heart disease to diagnose only 3% of eligible patients, despite the instrument having a high level of predictive accuracy (also see Sieck & Arkes, 2005, for similar results in experimental settings). A number of reasons have been suggested for this observed hesitancy, including the fact that professionals: (a) may be overly confident in their ability to outperform actuarial tools; (b) feel that a standardized tool cannot account for the unique features of individual people; (c) may not be aware of the research illustrating the accuracy of actuarial tools; (d) may not feel a suitable tool exists for their decision making context; or (e) feel that an actuarial approach is dehumanizing (Dawes et al., 1989; Kleinmuntz, 1990; Vrieze & Grove, 2009).

Several recent studies suggested that an additional reason for the lack of integration of simple actuarial tools is the distrust of such an approach by the recipients of decision outcomes. With relation to how people want information combined to make consequential decisions, Promberger and Baron (2006) found that people faced with a mock medical paradigm were more willing to follow and trust medical recommendations (i.e., proceed with surgical procedure) that came from a physician as opposed to those provided by a computer program. Similarly, Arkes, Shaffer, and Medow (2007) found that participants considered doctors who relied on an actuarial decision aid to have lower diagnostic ability than doctors who used their experience and intuition. In a follow-up study, Shaffer, Probst, Merkle, Arkes, and Medow (2013) found that participants had more negative views of doctors who relied on computerized decision aids compared to doctors who sought advice from an external human expert. Most recently, Wolf (2014) presented the same mock medical scenarios as used in Arkes et al. (2007) to IT students and found that participants rated the diagnostic ability of doctors who relied on a computerized decision aid lower than doctors who made unaided decisions. Outside of the medical context, business students have also been found to rely more on advice from a human expert rather than a statistical method when predicting stock prices (Önkal, Goodwin, Thomson, Gönül, & Pollock, 2009). Taken together, the clear message from these studies is that people are hesitant to have decisions made about them that are based on actuarial tools, and that they have negative attitudes toward professionals that choose to rely on such tools when making decisions.

It appears that only one study has examined attitudes toward both the information to be included in the decision and the way it is combined to arrive at a final decision (Eastwood, et al., 2012). Using legal (i.e., bail decision), medical (i.e., drug prescription decision), and academic (i.e., scholarship decision) scenarios, participants were provided with four different decision making approaches that varied according to (a) whether all or only some of the available information was included in the decision and (b) whether the information was combined intuitively using the professional's experience or by using a computer-based statistical formula. Across three samples, a clear preference emerged for intuitive-based approaches that included all of the available information (labelled the "human-is-better" and "more-is-better" effects, respectively). By contrast, the simple actuarial approach was rated consistently as the least preferred option, and was also seen as less accurate, fair, and ethical compared to the human-based approach that considered all possible information. These results suggest that the decision making approach that is arguably the most effective (i.e., simple actuarial) is also the approach that people are least favourable towards.

Although previous research attempted to explore variables that impact peoples' willingness to utilize simple actuarial tools (e.g., witnessing an algorithm make decision errors, Dietvorst, Simmons, & Massey, 2015; also see Arkes, Dawes, & Christensen, 1986; Goodwin, 2000), no studies to-date have tried to reduce directly the aforementioned resistance to simple actuarial approaches. The purpose of the current study was to assess whether providing information regarding the aforementioned advantages of simple actuarial tools would be effective in changing the current negative attitudes toward their usage. Research has shown that educational information can lead to attitude change, particularly if it includes strong arguments with compelling and falsifiable facts (Angst & Agarwal, 2009), uses positively framed arguments (i.e., focused on gains and beneficial outcomes; Jones, Sinclair, & Courneya, 2003; O'Keefe, 1990), and highlights the potential consequences of an issue (Wood, 2000). In addition, people are more likely to attend to, and be persuaded by, strong arguments and when the issue is personally relevant (Petty & Cacioppo, 1986).

In Study 1, a medical decision making scenario related to the prediction of heart attacks in emergency room patients was used, and in Study 2, a legal decision making scenario related to predicting future violence in inmates eligible for parole was used. These decision contexts were chosen because (a) they produce decision outcomes that could potentially impact most members of the general public and therefore would be of interest to them, and (b) previously constructed simple actuarial decision tools that were empirically demonstrated to be accurate and efficient exist in these contexts (Goldman et al., 1996; Quinsey, et al., 1998). In terms of the educational information, passages of text were constructed that stated clearly how the simple actuarial tool was more accurate and efficient, as well as the positive practical consequences associated with adopting simple actuarial tools within each of the two contexts. Based on the aforementioned research, it is hypothesized that participants that do not receive educational information would have negative attitudes toward simple actuarial tools. It was also hypothesized that the addition of each type of educational information (i.e., accurate, efficient) regarding the benefits of the tools would each independently increase positive attitudes toward the tools.

Study 1

Method

Sample. Participants (*N* = 404) were adults from across the United States of America. Of the participants who reported their gender, there were 180 men (M_{age} = 45.29, *SD* = 14.87, *Range* = 18-77) and 220 women (M_{age} = 45.66, *SD* = 16.11, *Range* = 20-81). There were 335 (82.92%) Whites, 27 (6.68%) from Multiple Races, 19 (4.70%) Asians, 11 (2.72%) Blacks, 6 (1.49%) Hispanics, 5 (1.24%) Native Americans, and 1 (0.25%) participant did not report ethnicity. Two participants (0.50%) had less than a high school degree, 47 (11.63%) had a high school degree or equivalent, 102 (25.25%) had some college but no degree, 34 (8.42%) had an associate degree, 110 (27.23%) had a bachelor degree, 107 (26.49%) had a graduate degree, and 2 (0.50%) participants did not report education levels. In terms of annual household income, 114 participants (28.22%) reported earning less than $50,000, 144 (35.64%) reported between $50,000 and $99,999, 54 (13.37%) reported between $100,000 and $149,999, 41 (10.15%) reported over $150,000, and 51(12.62%) did not provide household income.

Materials and Design. A medical scenario involving the diagnosis of chest pain in emergency room patients was used in the current study (see Appendix A for wording of the scenario). Participants were presented with the current procedure in which an emergency room doctor obtained and assessed up to 50 pieces of information from each patient and used their experience and training to categorize the patient's risk for having a heart attack. The final treatment decision was based on the doctor's categorization of risk. Participants were then presented with a new procedure in which 5 pieces of information from each patient were entered in a computer-based statistical program and the formula calculated the patient's risk for having a heart attack. The final treatment decision was based on the formula's categorization of risk. The details of the cues included in both procedures were taken from Goldman et al.'s (1996) development of an actual simple actuarial decision making tool for classifying patients complaining of acute chest pain. Information regarding the higher accuracy and the efficiency of the new approach, and specific practical implications of increased accuracy and efficiency, was outlined (see below).

Accuracy Information

Researchers had the statistical formula and doctors categorize thousands of past patients with severe chest pain. Their decisions were then compared to actual patient outcomes. Results showed that the statistical formula produced significantly more accurate categorization decisions than doctors. By being more accurate, the new categorization procedure will save lives by more precisely identifying patients who will actually have a heart attack. It will also save money by avoiding giving unnecessary treatments to patients who will not have a heart attack.

Efficiency Information

Researchers have collected extensive medical information from thousands of past patients with severe chest pain. This information was then analyzed statistically and compared to actual patient outcomes. Results showed that only the 5 pieces of information included in the above formula were needed to make accurate risk categorization decisions. By requiring less information, the new categorization procedure will save lives by diagnosing patients more quickly. It will also save money by requiring less medical tests and examinations to be conducted.

A 2 (Accuracy Information vs. No Accuracy Information) X 2 (Efficiency Information vs. No Efficiency Information) between participants-design was used. A survey consisting of 6 separate pages was constructed using SurveyMonkey (https://www.surveymonkey.com). The first page consisted of a consent form. The second page consisted of instructions regarding how to complete the survey. The third page contained demographic questions. The fourth page contained the medical decision making scenario outlined above and, depending on the condition, did or did not contain the information regarding the accuracy and efficiency of the new decision making procedure. The fifth page asked the participants to rate, using a 7-point scale, their satisfaction with the new procedure, as well rate the new procedure on its perceived fairness and ethicalness. Participants were also asked to indicate whether or not they would support the implementation of the new decision making procedure at their local hospital, and to record in as much detail as possible their reasoning for their answers to the above questions. The sixth page contained a debriefing form with further details about the purpose of the study.

Procedure. Participants were collected using SurveyMonkey's audience feature. Potential participants were contacted via email regarding an opportunity to complete a questionnaire in the SurveyMonkey system, and provided a link to access the questionnaire. Upon completion of the survey, SurveyMonkey donated 50 cents to a charity of the participants' choice. Participants did not receive direct compensation for participating in the study.[1]

Coding open-ended responses. Participant's responses to the open-ended question at the end of the survey were coded by the first author. A grounded approach to categorizing written text was used, whereby variables were derived through iterative refinement and the coding dictionary was modified until it reflected the content of responses across all participants (see House, Eastwood, & Snook, 2009 for an example of this approach). This process resulted in a total of 13 unique variables.[2] A research assistant, blind to the purpose of the study, also coded each participant's open-ended answer. The mean Kappa value for the coding of the open-ended responses was 0.63 (Percentage Agreement = 94%), suggesting substantial agreement between the two coders (Fleiss, 1981; Landis & Koch, 1977).

Confidence Intervals (CIs) and Effect Size calculations. As practical rather than statistical significance (Kirk, 1996) was of primary concern in this research, the use of 95% Confidence Intervals (CIs) and effect sizes (i.e., Cohen's *d*; Cohen, 1988) were emphasized for the presentation and interpretation of results. For the purpose of this analysis, CIs were interpreted as containing a range of plausible values for the population mean, while values outside the CI are relatively implausible (Cumming & Finch, 2005). In relation to significance testing when comparing CIs of two different means, when CIs do not overlap (or barely touch), then $p < .01$ (Cumming & Finch, 2005; Schenker & Gentleman, 2001). Effect sizes were interpreted using Cohen's (1988) guidelines for small ($d = 0.20$), medium ($d = 0.50$) and large ($d = 0.80$) effects.

Results

A 2 (Accuracy Information vs. No Accuracy Information) x 2 (Efficiency Information vs. No Efficiency Information) analysis of variance was computed on participants' overall satisfaction score. The ANOVA revealed only a significant main effect of Efficiency Information, $F(1, 400) = 10.23$, $p = .001$, with greater satisfaction for conditions that contained Efficiency Information ($M = 5.23$, $SD = 1.53$) than for those that did not ($M = 4.72$, $SD = 1.70$, $d = .32$). There was no main effect of Accuracy Information, $F(1, 400) = 1.39$, $p = .239$. The average satisfaction scores of conditions that did and did not contain Accuracy Information were 5.08 ($SD = 1.66$) and 4.88 ($SD = 1.60$), respectively ($d = 0.12$). The interaction did not reach significance.

The average satisfaction score (out of 7), and associated 95% CI, for each of the four conditions is shown in Figure 1. As can be seen, the highest level of satisfaction was observed when both information components (i.e., accuracy, efficiency) were present (M = 5.24, SD = 1.62, CI = 4.93, 5.55) and the lowest level of satisfaction was observed when none of the information components were present (M = 4.54, SD = 1.70, CI = 4.20, 4.88). The CI for the satisfaction scores of the No Information condition also did not overlap with the CIs for satisfaction scores of the Efficiency Information (d = 0.43) or Both Information conditions (d = 0.42).

A 2 (Accuracy Information vs. No Accuracy Information) x 2 (Efficiency Information vs. No Efficiency Information) ANOVA was also computed on the remaining two dependent measures. Participants in the Accuracy Information conditions rated the simple actuarial approach as more fair ($F(1, 400) = 3.98$, $p = .047$, $d = .20$) and ethical ($F(1, 400) = 4.15$, $p = .042$, $d = .21$) than those in the No Accuracy Information conditions. Similarly, participants in the Efficiency Information conditions rated the simple actuarial approach as more fair ($F(1, 400) = 4.23$, $p = .040$, $d = .21$) and ethical ($F(1, 400) = 7.74$, $p = .006$, $d = .28$) than those in the No Efficiency Information conditions. None of the interactions reached significance.

The average fair and ethical ratings (out of 7), and associated 95% *CI*s, for each of the four conditions are also shown in Figure 1. As can be seen, the highest ratings were observed when both information components were present (fairness: M = 5.23, SD = 1.48, CI = 4.95, 5.51; ethicalness: M = 5.20, SD = 1.57, CI = 4.90, 5.50) and the lowest ratings were observed when none of the information components were present (fairness: M = 4.62, SD = 1.64, CI = 4.30, 4.94; ethicalness: M = 4.41, SD = 1.69, CI = 4.08, 4.74). The CIs for the scores of the No

Information condition also did not overlap with the CIs for scores of the Both Information condition for the ethical (*d* = 0.48) measure.

The ratings of willingness to adopt the simple actuarial tool in their local hospital are shown in Figure 2. There was no significant difference between participant's willingness to adopt the simple actuarial tool as a function of condition, χ^2 (3, *N* = 404) = 6.94, *p* = .074. As can be seen, at least two thirds of participants in all conditions were in favour of adopting the new approach. Participants in the Both Information condition (81.31%, *CI* = 72.89%, 87.56%) were the most willing to adopt the simple actuarial tool, while those in the No Information condition were the least willing to adopt (66.00%, *CI* = 66.28%, 74.54%), with only a small overlap in *CI*s between the two conditions. There was substantial overlap in *CI*s between the three information conditions.

A total of 306 participants (75.74%) participants provided an open-ended response explaining the rationale behind their answers (note that only variables mentioned by over 5% of respondents are reported here). The most commonly mentioned factor was the efficient nature of the simple actuarial approach (*n* = 100; 32.68%). This was followed by the need for human involvement in the decision process (*n* = 61; 19.93%), improved patient outcomes with the simple actuarial approach (*n* = 58; 18.95%), the need for more information to be included in the simple actuarial formula (*n* = 43; 14.05%), and the increased accuracy of the simple actuarial approach (*n* = 32; 10.46%). Less commonly mentioned factors were the need for quick decisions when assessing chest pain (*n* = 28; 9.15%), the need for human experience and intuition in the decision process (*n* = 27; 8.82%), the need for the simple actuarial formula to consider unique aspects of each patient (*n* = 24; 7.84%), and using the simple actuarial tool as just an additional input considered by a human decision maker (*n* = 21; 6.86%).

Discussion

The purpose of Study 1 was to measure the impact of educational information on attitudes toward a simple actuarial tool in a medical decision making context. Contrary to the first prediction, and in contrast to previous research measuring attitudes toward actuarial tools, participants were generally positive about the simple actuarial tool. For example, two-thirds of the people in the control condition – who received no educational information – reported being in favour of adopting the tool in their local hospital. There are several potential explanations for this somewhat surprising finding. First, given the increased usage of technology within hospital settings (e.g., MRI machines, EEGs, ultrasound), people may be more comfortable with computers being involved in medical decision making. Second, given that the survey was conducted online, the sample may simply have been more comfortable with technology than samples in past studies. However, this explanation seems less likely given that previous research has shown that IT students (Wolf, 2014) and those with a positive attitude toward statistics (Shaffer et al., 2013) were less accepting of diagnoses from physicians who used computerized decision aids. Third, people may have a positive view of the simple actuarial tool because the current scenario only mentioned that the formula was “more accurate” and no indication of its actual error rate or specific past incorrect decisions were presented – past research has shown that peoples’ confidence in the actuarial approach will be lowered when they see the algorithm err (see Dietvorst et al., 2015).

A fourth, and arguably most likely explanation, is that the increased acceptance was a result of the scenario used. Specifically, the medical situation (i.e., diagnosing severe chest pain) was one in which the ability to make a rapid decision was of primary importance. This is in contrast to previous studies in which the diagnostic situation did not require an urgent decision (e.g., injured ankle, sore throat). Even without educational information, participants could easily deduce that the simple actuarial tool's reliance on less information and automated decision making would lead to much quicker decisions than the human-based and information-intensive approach – which is supported by the high efficiency rating given to the tool regardless of condition. This explanation also appears to match the reasoning given by many participants in their open-ended responses, as the most commonly mentioned rationale for supporting the simple actuarial tool was its ability to make quick and efficient decisions.

In line with the second prediction, it was found that making people aware of the specific benefits of a simple actuarial medical diagnostic tool led to more positive attitudes toward the tool. The effect sizes between the No Information and Both Information conditions were all positive and ranged from d = 0.39 to d = 0.48 (average d = 0.43), while the CIs for the means of these two conditions did not overlap for two of the three dependent measures (i.e., satisfaction and ethicalness). These results suggest a true but relatively small impact of education information on attitudes toward simple actuarial tools. However, it should also be noted that a 15% increase in willingness to adopt the tool locally (i.e., 81% vs. 66%) between the two conditions represents an important practically significant difference. It is likely that the unexpectedly high positive attitudes in the No Information condition limited the ability of the information to change attitudes more strongly, and the impact of educational informational may be larger in contexts where people are naturally less accepting of simple actuarial tools.

Although both accuracy and efficiency information led to increased positive attitudes, it appears that efficiency information was somewhat more persuasive. Similar to the explanation for the increased acceptance of actuarial tools generally, the increased influence of efficiency information may be due to the time-sensitive nature of the scenario used in Study 1. That is, participants may have been influenced strongly by information regarding the ability of the simple actuarial tool to make quick decisions and the specific benefits of quicker decisions in this context (i.e., identify who is at high risk for heart attack). This explanation is supported by the fact that almost 10% of the respondents explicitly mentioned in their open-ended responses the need to make quick decisions in this scenario.

Overall, the findings from Study 1 suggest that although educational information may be effective in increasing acceptance of simple actuarial tools, attitudes toward these tools may be context-dependent.

Study 2

Method

Sample. Participants (N = 325) were adults from across the United States of America. Of the participants who reported their gender, there were 102 men (M_{age} = 50.55, SD = 15.91, *Range* = 19-87) and 221 women (M_{age} = 42.68, SD = 17.45, *Range* = 19-83). There were 268 (82.46%) Whites, 21 (6.46%) Blacks, 17 (5.23%) from Multiple Races, 6 (1.85%) Hispanics, 6 (1.85%) Native Americans, 2 (0.62%) Asians, and 5 participants (1.54%) did not report ethnicity. One participant (0.31%) had less than a high school degree, 27 (8.31%) had a high school degree or equivalent, 83 (25.54%) had some college but no degree, 34 (10.46%) had an associate degree, 101 (31.08%) had a bachelor degree, 78 (24.00%) had a graduate degree, and 1 (0.31%) participant did not report education levels. In terms of annual household income, 107 participants (32.92%) reported earning less than $50,000, 101 (31.08%) reported between $50,000 and $99,999, 46 (14.15%) reported between $100,000 and $149,999, 31 (9.54%) reported over $150,000, and 40 (12.31%) declined to answer.

Materials and Design. A legal scenario involving the prediction of future violence in inmates applying for parole was used in the current study (see Appendix B for wording of the scenario). Participants were presented with the current procedure in which a prison psychologist assessed up to 120 pieces of information from each inmate and used their experience and training to categorize the inmate’s risk for engaging in future violence. The final parole decision was based on the psychologist’s categorization of risk. Participants were then presented with a new procedure in which 12 pieces of information were entered in a computer-based statistical program and the formula calculated the inmate’s risk for engaging in future violence. The final parole decision was based on the formula’s categorization of risk. The details of the cues included in both procedures were adapted from Quinsey et al.’s (1998) and Steadman et al.’s (2000) development of simple actuarial tools for making risk assessment decisions. Information regarding the higher accuracy and the efficiency of the new approach, and specific practical implications of the accuracy and efficiency, was outlined (see below).

Accuracy Information

Researchers had the statistical formula and psychologists categorize thousands of past inmates applying for parole. Their decisions were then compared to actual inmate outcomes. Results showed that the statistical formula produced significantly more accurate categorization decisions than psychologists. By being more accurate, the new categorization procedure will save lives by more precisely identifying inmates who will actually engage in violence if released and thus keep them in prison. It will also save tax payers’ money by avoiding keeping inmates in jail who would not engage in violence if released.

Efficiency Information

Researchers have collected extensive information from thousands of past inmates applying for parole. This information was then analyzed statistically and compared to actual inmate outcomes. Results showed that only the 12 pieces of information included in the above formula were needed to make accurate risk categorization decisions. By requiring less information, the new categorization procedure will save time by categorizing inmates more quickly. It will also save tax payers' money by requiring less information to be collected by prison staff.

The same survey design as outlined in Study 1 was used in Study 2, with the exception of the change to a parole decision making scenario and asking whether or not they would support the implementation of the new decision making procedure at a prison in their state.

Procedure. The same procedure as outlined in Study 1 was followed for Study 2, including the process of coding open-ended responses. A total of 18 unique variables were identified, and the mean Kappa value for the coding of the open-ended responses between the first author and the research assistant was 0.65 (Percentage Agreement = 93%), suggesting substantial agreement between the two coders (Fleiss, 1981; Landis & Koch, 1977).

Results

A 2 (Accuracy Information vs. No Accuracy Information) X 2 (Efficiency Information vs. No Efficiency Information) analysis of variance was computed on participants' overall satisfaction score. The ANOVA revealed a significant main effect of Accuracy Information, $F(1, 321) = 33.32$, $p < .001$. The average satisfaction scores of conditions that did and did not contain Accuracy Information were 4.79 ($SD = 1.53$) and 3.85 ($SD = 1.58$), respectively ($d = 0.60$). There was also a significant main effect of Efficiency Information, $F(1, 321) = 11.28$, $p = .001$, with greater satisfaction for conditions that contained Efficiency Information ($M = 4.58$, $SD = 1.49$) than for those that did not ($M = 4.03$, $SD = 1.72$, $d = .34$). The was also a significant interaction effect, $F(1, 321) = 6.42$, $p = .012$, where the effect of Efficiency Information was much larger when Accuracy Information was not present than when it was present.

The average satisfaction score (out of 7), and associated 95% CIs, for each of the four conditions is shown in Figure 3. As can be seen, the highest level of satisfaction was achieved when both information components were present ($M = 4.86$, $SD = 1.52$, $CI = 4.93, 5.19$) and the lowest level of satisfaction was achieved when none of the information components were present ($M = 3.32$, $SD = 1.60$, $CI = 2.95, 3.69$). The CI for the satisfaction scores of the No Information condition did not overlap with the CIs for satisfaction scores of the Accuracy Information ($d = 0.89$), Efficiency Information ($d = 0.65$), or Both Information ($d = 0.99$) conditions.

A 2 (Accuracy Information vs. No Accuracy Information) X 2 (Efficiency Information vs. No Efficiency Information) ANOVA was also computed on the remaining two dependent measures. Participants in the in the Accuracy Information conditions rated the simple actuarial approach as more fair ($F(1, 321) = 21.87$, $p < .001$, $d = .49$) and ethical ($F(1, 321) = 21.29$, $p < .001$, $d = .50$) than those in the No Accuracy Information conditions. Participants in the Efficiency Information conditions rated the simple actuarial approach as more fair ($F(1, 321) = 4.24$, p = .040, $d = .21$) compared to those in the no Efficiency Information conditions, while there was no effect for ratings of ethicalness, $F(1, 321) = .92$, $p = .339$, $d = .10$. There was also a significant interaction effect for ratings of fairness ($F(1, 321) = 7.55$, $p = .006$) and ethicalness ($F(1, 321) = 5.24$, $p = .023$) – in both cases the effect of Efficiency Information was larger when Accuracy Information was not present than when it was present.

The average fair and ethical ratings (out of 7), and associated 95% CIs, for each of the four conditions are also shown in Figure 3. As can be seen, the highest ratings were observed when only accuracy information was provided (fairness: $M = 4.97$, $SD = 1.53$, $CI = 4.63, 5.31$;

ethicalness: *M* = 4.78, *SD* = 1.53, *CI* = 4.44, 5.12) and the lowest ratings were observed when none of the information components were present (fairness: *M* = 3.71, *SD* = 1.66, *CI* = 3.34, 4.08; ethicalness: *M* = 3.57, *SD* = 1.68, *CI* = 3.19, 3.95). The results also show that the CIs for the scores of the No Information condition did not overlap with the CIs for the scores of the Both Information condition for the measures of fairness (*d* = 0.73) and ethicalness (*d* = 0.59).

The ratings of willingness to adopt the simple actuarial tool in their local prison are shown in Figure 2. There was a significant statistical difference between participant's willingness to adopt the simple actuarial tool as a function of condition, χ^2 (3, *N* = 352) = 30.67, *p* <.001. As can be seen, participants in Accuracy Information condition (71.79%, *CI* = 60.97%, 80.57%) were the most willing to adopt the simple actuarial tool, while participants in the No Information condition (30.26%, *CI* = 21.09%, 41.33%) were the least willing to adopt the tool. There was a high degree of CI overlap between the three Information conditions, however the CI for the No Information condition did not overlap with the CIs for the other three conditions.

A total of 277 of the participants (85.23%) provided an open-ended response explaining the rationale behind their answers (note that only variables mentioned by over 5% of respondents are reported here). The most commonly mentioned factor was the need for human involvement in the decision process (*n* = 102; 36.82%, see Figure 2). This was followed by the efficient nature of the simple actuarial approach (*n* = 62; 22.38%), the need for the simple actuarial formula to consider unique aspects of each inmate (*n* = 43; 15.52%), the need for more information to be included in the simple actuarial formula (*n* = 42; 15.16%), using the simple actuarial tool as just an additional input considered by a human decision maker (*n* = 34; 12.27%), the unbiased nature of the simple actuarial tool (10.83%), and the need for human experience and intuition in the decision process (*n* = 28; 10.11%). Less commonly mentioned factors were the increased accuracy of the simple actuarial approach (n = 27; 9.75%), concerns about the integrity of the computerized system (e.g., viruses, inaccurate entry of data; n = 22; 7.94%), and the desire for more research on the validity of the simple actuarial approach (n = 20; 7.22%).

Discussion

Consistent with the first prediction, participants who did not receive educational information had negative attitudes toward the simple actuarial tool. Specifically, less than a third of participants in the No Information condition were in favour of adopting the parole procedure in their local prison, and rated the simple actuarial tool lower across the dependent measures. This finding is consistent with past research showing that people have negative attitudes towards the use of simple actuarial tools in legal contexts (Eastwood et al., 2012).

Consistent with the second prediction, both types of information (i.e., accuracy and efficiency) led to increases in positive attitudes towards the simple actuarial tool. The effect sizes between the No Information and Both Information conditions were all positive and ranged from d = 0.59 to d = 0.99 (average d = 0.77), while the CIs for the means of these two conditions did not overlap for all three dependent measures (i.e., satisfaction, fair, ethical). These results suggest a true and relatively large impact of education information on attitudes toward simple actuarial tools. Furthermore, the willingness to adopt the procedure in a local state prison more than doubled (i.e., 30% to 64%) when both types of information were presented to participants.

The results also showed that accuracy information led to larger effect sizes across the dependent measures compared to efficiency information (average d = 0.53 and d = 0.22, respectively). In addition, the condition in which only accuracy information was provided produced the highest percentage of participants willing to adopt the simple actuarial tool locally. This increased effect of accuracy information may be because participants were less concerned about the need to make quick decisions and more focused on ensuring that correct decisions were made (i.e., violent offenders were not released). This explanation is reinforced by the results of the analyses of participants' open-ended responses, as many participants referred to the inability of computer to accurately consider the unique aspects of complex human behaviour and the need to have a human involved in the decision process to ensure accurate decisions were made, while no participants mentioned the need for quick decisions to be made in this scenario. Furthermore, in the conditions in which accuracy information was not provided, 46% of respondents reported a desire to have human oversight of the decision process, compared to only 27% of respondents in the conditions where accuracy information was provided – further suggesting that as accuracy concerns were allayed, participants became more accepting of the simple actuarial tool.

The findings from Study 2 further suggest that making people aware of the advantages of simple actuarial tools – and the accompanying practical benefits – will reduce resistance to their implementation greatly.

General Discussion

Past research has shown consistently that people hold negative attitudes toward simple actuarial tools and those who use them, and instead prefer decisions be made intuitively using all available information (i.e., "more-is-better" and "human-is-better" effects). These negative attitudes toward simple actuarial tools persist despite research showing that such tools lead to much more accurate and efficient decisions, which in turn may lead to many practical benefits in real-world situations (e.g., more efficient and accurate medical diagnoses and recidivism predictions). The purpose of the current experiments was to determine if providing people with education regarding the benefits of simple actuarial tools would increase their attitudes towards them. Across two different decision making scenarios (i.e., medical and legal), providing people with information regarding the practical benefits of simple actuarial tools greatly increased positive attitudes toward these tools. Contrary to expectations, however, the expected dislike of simple actuarial tools appeared primarily in the legal decision making scenario and the relative impact of the type of information differed across scenarios. While researchers should be prudent when making comparisons across studies, these results suggest that the effect of educational information may be context dependent. Overall, this study suggests that the implementation of simple actuarial tools can be facilitated if people are provided with information regarding their advantages.

Providing people with direct statements regarding the increased accuracy and efficiency of simple actuarial tools compared to human-based and information-intensive decision making approaches – and the resulting practical benefits of these advantages – was effective in increasing acceptance of the tools. Not only did satisfaction ratings increase by an average of 16% between the No Information and Both Information conditions, over 70% of participants in Study 1 and Study 2 were in favour of adopting the simple actuarial tool in either the Both Information (medical scenario) or Accuracy Information (legal scenario) conditions. This finding is in direct contrast to previous research showing that: (a) people consistently rate a simple actuarial approach as the least preferred decision making option (e.g., Eastwood et al., 2012); (b) are less likely to follow advice from a computer program than a physician (Promberger & Baron, 2006); and (c) hold a variety of negative attitudes towards professionals who chose to use actuarial tools in practice (e.g., Arkes et al., 2007; Shaffer et al., 2013, Wolf, 2014). The current study provides support for the idea that the lack of acceptance of simple actuarial tools by the general public may be at least partially because of ignorance regarding their advantages. By making people aware of this information, acceptance of the tools will likely increase.

Along with ratings of satisfaction, providing educational information led to the simple actuarial tools being seen generally as more fair and ethical across both studies; a finding that is in contrast to research showing that these types of approaches are consistently rated as less fair and ethical than human-based and information-intensive approaches (e.g., Eastwood et al., 2012). The high ratings for fairness and ethicalness also run counter to the argument that actuarial tools may be seen as dehumanizing due to their automated nature (see Dawes et al., 1989). The results of the current study suggest that the reason for the previous lower ratings for measures such as fairness and ethicalness were at least partially due to concerns about the accuracy and efficiency of simple actuarial tools. By countering these beliefs with educational information, people viewed the simple actuarial tools as more ethically appropriate for use in practice. The results of the current study further support the conclusion that if people are made aware of the accuracy and efficiency of simple actuarial tools, their attitudes toward their usage will become more positive.

Although both types of educational information (i.e., accuracy and efficiency) led to increased positive attitudes, their impact did differ across the two scenarios. Specifically, efficiency information had a larger impact in the medical scenario, while accuracy information appeared to be more persuasive in the legal scenario. In addition, the base rate of satisfaction ratings for the simple actuarial tool was much higher in the medical scenario compared to the legal scenario. These results suggest that the perception of simple actuarial tools and their benefits may be context dependent. As captured in the open-ended responses, the main reason for the difference in attitudes appears to be the level of urgency and complexity associated with the decision context. The medical scenario involved the need for an immediate decision using risk factors that presumably predicted heart attack likelihood consistently across individuals. Thus, a formulaic system that could quickly categorize patients while maintaining a high level of accuracy was viewed relatively positively, even without educational information. By contrast, the parole scenario involved no explicit time constraints and the ostensibly more difficult task of predicting long-term future human behavior. Given the lack of need for quick decisions in the parole scenario, the primary concern was regarding the formula’s ability to deal with the complexities of human behavior, and therefore accuracy information was more persuasive. Overall this suggest that attitudes toward simple actuarial tools may be relatively high in time-sensitive and straightforward decision making situations, and that the type of educational information provided may need to be tailored to the specific decision context in order to be effective.

The ability of educational information to improve attitudes toward simple actuarial tools is consistent with the overall attitude change literature. Specifically, the scenarios were chosen to be relatively relevant to participants and they were asked about their willingness to adopt the tool in their *local* hospital or prison in *their state*, and the educational information provided multiple clear and strong arguments regarding the advantages and positive benefits of the tools – all of which are likely to lead to strong attitudinal change (see Petty & Cacioppo, 1986). It should be noted, however, that approximately 20% (medical scenario) and 35% (legal scenario) of participants in the Both Information conditions still did not favour implementation of the tools, suggesting that future research is needed to identify ways to further increase attitudes toward simple actuarial tools. For instance, future research could examine whether increasing the strength of the argument, or highlighting improvements beyond increased accuracy and efficiency could improve attitudes toward simple actuarial tools.

There are at least five aspects of the current study that may limit its generalizability. First, while the scenarios used were chose to maximize relevance to people, they were hypothetical scenarios that may not have captured the complexity of real-world decision contexts. Although the use of hypothetical scenarios is common in this field (e.g., Eastwood et al., 2012; Promberger & Baron, 2006), future research should focus on the impact of educational information in real-world settings (e.g., conduct a survey in a hospital waiting room). Second, the current research only focused on attitude change, and therefore direct conclusions about how such reported attitude change may impact actual behaviour cannot be made. Third, because only simple actuarial and human-based information intensive conditions were used, it is not possible to tease out effects of *what information was considered in the decision* vs. *how the information was combined*. Future research should attempt to identify the exact locus of the effect. Fourth, the exact accuracy and efficiency gains associated with the simple actuarial tool was purposefully left vague (e.g., participants were simple told that new approach was “more accurate”). Future research should examine whether providing more precise information impacts peoples’ acceptance of the tools, as previous research has suggested it may impact usage of decision aids (Kaplan, Reneau, & Whitecotton, 2001). Fifth, participants were provided with information about how the new decision making approaches were accurate and efficient, along with the practical benefits of being more accurate and efficient (e.g., saving lives, being more cost effective). The purpose of including both informational aspects was to ensure the manipulation was as strong as possible given that this is the first known attempt to directly manipulate peoples’ attitudes toward actuarial decision making approaches. Furthermore, from a practical perspective this is information that would be available in real-world contexts if practitioners did wish to attempt to articulate to clients the reasons why an actuarial approach is preferable. Future research should attempt to further investigate the relative strength of the types of information (and perhaps other types of information not considered in these studies as well).

Practical Implications for Professional Psychological Practice

In direct predictive decisions, research-based actuarial tools have been shown to consistently outperform unaided human-based decision making – including within clinical psychological settings (see Grove et al., 2000). However, the actual implementation of these tools into professional practice has been relatively limited, and one potential explanation for the lack of usage is the hesitation of patients/clients to have decisions made about them using such simple actuarial tools. Results from this study suggest that practitioners within clinical psychology settings – as compared to other decision making domains – may face increased difficulty when attempting to utilize and implement simple actuarial tools. Given the perceived increased complexity of predicting future human behaviour, many participants in the control condition of the parole scenario reported that statistical formulas could not perform this task accurately and that human-based decision making needed to take precedence.

Despite the initial hesitation, when provided with educational information regarding the advantages and benefits of these tools – and in particular their ability to make more accurate predictive decisions – attitudes toward them and the willingness to have them adopted in practice increased greatly. The positive attitudes suggest that psychological professionals may be able to overcome hesitations regarding simple actuarial tools if they take the initiative to explain the reason for their usage and their associated benefits. However, the open-ended comments suggested that even when convinced of the accuracy of the simple actuarial tool, many participants still wanted some level of human oversight – with the actuarial tool acting as an important piece of additional piece of information to be considered by a clinician. Although this hybrid approach may appear a reasonable solution, caution must be taken as less accurate decisions may be made due to the inability of human decision makers to identify consistently when they should deviate from the formula's prediction (Dawes et al., 1989; Whitecotton, Sanders, & Norris, 1998; Zacharakis & Sheppard). Practically speaking, however, people may never be comfortable removing human involvement completely from the clinical predictive processes and therefore a human professional may need to be included.

Overall, the results of the current study are encouraging as they suggest that an educational approach can assist in the implementation of simple actuarial tools – and the realization of the practical benefits associated with increased usage of those tools – in many real-world decision contexts.

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Appendix A

A common symptom reported by emergency room patients is severe chest pain. Hospital staff must then categorize the patients' risk level for having an actual heart attack. This categorization of risk is then used to make treatment decisions. This decision has very important implications for both the hospitals and patients. A hospital is considering a new procedure for making their categorization decisions. The details of the current procedure and the proposed new procedure are outlined below.

Current Categorization Procedure

The current procedure requires the hospital staff to collect approximately 50 pieces of information from each patient. This includes historical data (description of symptoms, family medical history, prescribed medications, etc.), a physical examination (blood pressure, chest tenderness, heart murmurs, etc.), and results from an electrocardiogram (EKG) test. An emergency room doctor reviews all this information. They then decide each patient's risk level of having a heart attack. This decision is made intuitively, based on the doctor's experience and training. The final treatment decision is based on the doctor's categorization of risk.

Proposed New Categorization Procedure

The new procedure will require the hospital staff to collect 5 pieces of information from each patient. This includes two results from the EKG test, blood pressure, reported pain level, and lung sounds. This information will be entered into a computer-based statistical formula. The formula will calculate each patient's risk level of having a heart attack. This formula was created by using the information that was important for predicting risk levels in previous patients. The final treatment decision will be based on the formula's categorization of risk.

Appendix B

A common event within prisons is an inmate applying to be released on parole. When an inmate applies for parole, prison staff must categorize the inmate's risk level for engaging in future violent behavior. This categorization of risk is then used to make a decision of whether or not to grant parole to the inmate. This decision has very important implications for both the inmates and the general public. A prison is considering a new procedure for making their categorization decisions. The details of the current procedure and the proposed new procedure are outlined below.

Current Categorization Procedure

The current procedure requires the prison staff to collect approximately 120 pieces of information from each inmate. This includes information regarding personal factors (age, gender, etc.), historical factors (abused as a child, criminal history, etc.), situational factors (social support network, employment, etc.), and clinical factors (experiencing delusions, mental illness, etc.). A prison psychologist reviews all of this information. They then decide each inmate's risk level of engaging in future violent behavior. This decision is made intuitively, based on the psychologist's experience and training. The final parole decision is based on the psychologist's categorization of risk.

Proposed New Categorization Procedure

The new procedure will require the prison staff to collect 12 pieces of information from each inmate. This includes information within the same four factors as the current procedure (personal, historical, situational, and clinical). This information will be entered into a computer-based statistical formula. The formula will calculate each patient's risk level of engaging in future violent behavior. This formula was created by using the information that was important for predicting risk levels in previous inmates. The final parole decision will be based on the formula's categorization of risk.

Footnotes

[1]For Study 1 and Study 2, all participants who completed the surveys were included, and all measures, conditions, and data exclusions were reported. While sample size was not conducted *a priori*, post-hoc power analysis reveals that Study 1 had 85% power and Study 2 had 99% power.

[2]A full list of variables and the associated coding dictionary for the open-ended responses in both Study 1 and Study 2 can be obtained from the corresponding author.