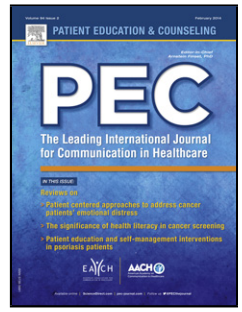


Title: Exploiting order effects to improve the quality of decisions

Author: Nick Bansback Linda C. Li Larry D. Lyndc Stirling Bryan

PII: S0738-3991(14)00226-2
DOI: http://dx.doi.org/doi:10.1016/j.pec.2014.05.021
Reference: PEC 4802

To appear in: *Patient Education and Counseling*

Received date: 11-12-2013
Revised date: 8-5-2014
Accepted date: 25-5-2014

Exploiting order effects to improve the quality of decisions

Nick Bansback[1,2,3], Linda C. Li[4], Larry D. Lynd[3,5], Stirling Bryan[1,2]

1. School of Population and Public Health, University of British Columbia, Vancouver, Canada.
2. Centre for Clinical Epidemiology and Evaluation, Vancouver Coastal Research Institute, Vancouver, Canada.
3. Centre for Health Evaluation and Outcome Sciences, St Paul's Hospital, Vancouver, Canada.
4. Department of Physiotherapy, University of British Columbia, Vancouver, Canada.
5. Faculty of Pharmaceutical Sciences, University of British Columbia, Vancouver, Canada.

Corresponding author:

Nick Bansback,
School of Population and Public Health,
University of British Columbia,
2206 East Mall,
Vancouver,
BC, V6T 1Z3
Canada
Email: nick.bansback@ubc.ca
Telephone: 604-827-5453
Fax: 604-806-8778

Abstract

Objective

To examine the effect of ordering information in a patient decision aid (PtDA) about treatments for obstructive sleep apnea (OSA).

Methods

We recruited 643 individuals to imagine that they had been diagnosed with OSA and to choose between treatment options. A value clarification exercise was used to determine which attributes of treatment mattered most to each individual. Before deciding on their preferred treatment option, we randomly assigned participants to view information with attributes in: a pre-specified order (Group 1), order of what mattered most last (Group 2), and first (Group 3).

Results

Of the 510 participants who provided usable results, viewing information that mattered most first was associated with choosing the treatment option most concordant with their informed values. The order effect was most pronounced in younger individuals.

Conclusions

In this study of hypothetical patients, order effects were found to improve the information patients focussed on, potentially improving the quality of their decisions.

Practice implications

The order of information presented in a PtDA can inadvertently influence patients' choices. By tailoring information order for each patient, developers can not only overcome this dilemma, but also make it simpler for patients to choose the option that is best for them.

1. Introduction

Patient decision aids (PtDAs) are interventions designed to provide the best evidence available about the risks and benefits of different medical treatment options.[1] PtDAs assist patients in clarifying and communicating the values they place on different features of treatment options. By doing so, they can help patients make informed decisions in consultation with their physicians, an approach known as shared decision making.[2]

Developers of PtDAs strive to improve the quality of treatment choices, or decision quality. A quality choice has been defined as one that is both informed and value concordant; that is the patient's choice is based on knowledge of options and outcomes, including accurate perceptions of risk, such that the chosen option matches the patient's personal values.[3] A wealth of research has sought to improve PtDAs so that patients receive accurate and well-described information.[4] However, evidence suggests that simply providing patients with accurate information does not always lead to quality decision-making.[5] Often, informed patients must make difficult trade-offs.[6] When a patient is faced with complex and unfamiliar information, their trade-offs can be overridden by subtle cognitive biases.[7,8] In the case of PtDAs, this may lead to patients choosing options that are not concordant with their personal values.

This study focusses on a cognitive bias caused by order effects. The psychology literature has established that the order in which information is presented can influence people's judgments.[9–11] People can be influenced by a recency bias— they may remember the most recent information they receive better than earlier information and, as a result, their perceptions can be disproportionately influenced by this recent information.[12] Accordingly, patients who learn about treatment benefits first and risk information second might better remember the risks, and make treatment choices that are more influenced by this recently received risk information. People can also be influenced by a primacy bias – they may better consider the information listed first rather than last, particularly where the list is long.[13] In these circumstances, patients might give more weight to information provided earlier relative to information given further down a list.[14] These types of biases are a potential problem to developers of PtDAs who seek to inform patients about treatment options in a neutral manner. Information, such as harms or benefits, must be presented in some order within a PtDA, but since developers choose this order they may inadvertently influence the patient to choose a particular option.

While other studies have sought to minimize the influence of such order effects,[15] this study seeks to exploit these effects by simplifying the task for patients faced with complex decisions. Using an experimental design, we test whether ordering information in accordance to what matters most to a given person influences the option that is chosen. The results illustrate how developers can tailor PtDAs using dynamic and interactive processes.

2. Methods

2.1 Overview

We used a PtDA in development for patients with obstructive sleep apnea which is designed to assist patients choice between three options: i) Continuous Positive Airway Pressure (CPAP), a machine that pushes a stream of air through a mask into a patient's nose or mouth to keep his throat and airway open; ii) a Mandibular Advancement Splint (MAS), a type of mouthguard that helps to keep the patient's throat open; and iii) no treatment, or not adhering to using either CPAP or MAS. A recent review concluded that "the decision as to whether to use CPAP or MAS will likely depend on patient preference."[16]

We invited members of an online panel to imagine they had been diagnosed with sleep apnea and were to use the PtDA to help their physician prescribe the most appropriate treatment option. They were told that adherence to these treatments was a particular concern, and so personal preferences were important to making treatment decisions.

The PtDA broadly followed the IPDAS guidelines,[17] explaining the condition, providing information about options and their characteristics (benefits, side-effects, costs, etc.) using probabilities and pictographs to describe baseline and incremental absolute risks where appropriate, a value clarification exercise, and a summary of information to help the patient deliberate on the decision along with an opportunity to select the preferred option. Given the hypothetical nature of the exercise, we did not include guidance on next steps or on ways to discuss options with others, which would typically be included in a PtDA.

Respondents were randomised to three different versions of the PtDA: 1) conventional group, where the order of the information was pre-specified with benefits listed first, followed by side-effects, and then costs; 2) recency group, where information was ordered based on the results of a value clarification exercise, so that what a given respondent valued most was listed *last*; and 3) primacy group, where information again was ordered according to values, so that what a respondent valued most was listed *first*. The information contained in all three versions was identical, but the order in which information was displayed varied. We asked respondents questions about their preferred option and asked them to assign values to the attributes associated with each option. As a result we were able to determine the proportion of respondents who chose the option concordant with their own values.

2.2 Survey procedure

After completing consent, participants were informed that the survey was for improving an educational tool for patients with sleep apnea. They were then given information about sleep apnea so they could imagine that it would be like to have the condition. A simple test, referred to as a "catch trial," was used to ensure they had paid attention to the information page. Individuals were then presented a screen with an overview of attributes, with a description of their ranges. The attributes had been selected based on previous qualitative research.[18] The attributes included: *efficacy* – CPAP is more effective than MAS, while both are more effective than no treatment; *comfort* – CPAP requires users to sleep on their backs with a mask while MAS can cause some discomfort; *side effects* – both CPAP and MAS can cause minor side-effects such as dry mouths or sore jaws; *practicality* – CPAP is cumbersome to travel with while the MAS is small and convenient; *partner considerations* – CPAP can be noisy and embarrassing to use, and; *cost* – CPAP tends to have a smaller up front cost than MAS, but has ongoing costs for replacement masks.

Those randomized to the ordered PtDA versions (Groups 2 and 3) were then presented a value clarification exercise (Group 1 was shown the exercise at the end which is the convention in PtDAs) (Figure 1). The value clarification exercise used a series of rating scales to elicit from individuals what attributes mattered most to them and in what order. To reduce the chance for equivalent ratings and to encourage compensatory decision-making, we enabled the scales to derive values from 1-100 each starting at 16.6 (100/6), and linked them such that the sum of the scales always equalled 100 (an interactive constant sum exercise).

The ordered groups then viewed each page in accordance with these rankings – in descending order for the primacy group and ascending for the recency group – such that each individual viewed the information in a different order. The conventional group viewed each information page in a fixed order and conducted the value clarification exercise after viewing the information in the pre-specified order (Figure 1). All groups then viewed a balance sheet where all the information was summarized in one page (again, ordered as per group),[19] and asked to indicate which option they preferred. All groups could go back to the value clarification exercise and revise their values at any time.

The final stage of the survey asked a series of outcome measures including a leaning scale, the decisional conflict scale (DCS), and the DCS uncertainty and values clarity subscales.[20] The final task asked participants to rate each treatment's impact on each attribute on a 5-item Likert scale.

2.3 Outcomes

The primary outcome was concordance between each individual's calculated optimal treatment, based on their individual values and scores, and the option they actually selected. A perfect outcome for optimal treatment is unachievable, and so we used a multi criteria decision analysis (MCDA) framework to calculate respondents' scores for each option.[21] The values for each attribute (obtained from the value clarification exercise) were multiplied by the scores assigned to each option for each attribute. The sum gave a weighted score for each option, with the largest score indicating the individual's optimal option.

Perceived clarity of values and uncertainty were measured using two subscales from the well-validated decisional conflict scale.[22] These six items are coded on 5-point scales ranging from "strongly agree" to "strongly disagree." The items for the perceived clarity of values subscale are: "I am clear about which benefits matter most to me," "I am clear about which risks and side effects matter most to me," and "I am clear about which is more important to me (the benefits or the risk and side effects)." The uncertainty subscale items are: "I am clear about the best choice for me," "I feel sure about what to choose," and "This decision is easy for me to make."

2.4 Participants

In a preliminary pilot study of 60 persons used to test the survey was working correctly, approximately 65% of participants chose an option concordant with their values. A convenience sample of 500 individuals (approximately 166 in each arm) was therefore calculated to be able to detect a 15% difference with 80% power, at a type I error of 5%. We advertised both the pilot and main survey to North American participants using Amazon Mechanical Turk.[23]

2.5 Analysis

A generalized logit model for multinomial responses was used to determine the odds ratio for choosing either CPAP or MAS relative to the conventional group. A logistic regression was used to test for differences in concordance between each group, adjusted for age, sex, and education. Each DCS subscale was converted to a 1-100 score where a lower score meant the participant was less conflicted, and linear regression models were performed to compare the scores relative to the conventional group, adjusted for age, sex, and education. All analyses were conducted in SAS 8.2.

3. Results

3.1 Sample and demographics

In just over two weeks, 643 individuals began the survey. Of these, 76 respondents failed to complete the survey, and a further 35 failed the catch trial. Eleven respondents had duplicate IP addresses and similar characteristics and so their second response was removed. This left 521 responses available for analysis (Figure 1).

In the total sample, respondents were predominantly aged between 26-35 years, 61% were female, and approximately 60% of respondents had at least a college degree. The demographics were generally well balanced between groups (Table 1).

On average, respondents considered the efficacy of treatment to be the most important attribute, followed by cost, partner considerations, and comfort. Side effects and practicality were the least valued. However, there was considerable heterogeneity between respondents' values and in the ordered groups (2 and 3) there were 112 unique rank orderings. Consequently, few respondents in these groups viewed the same version of the PtDA; there were effectively 112 individually tailored versions.

3.2 Choices

Overall, respondents stated they preferred the MAS option, followed by CPAP and no treatment (Table 2). In comparison to the conventional group, respondents randomized to the primacy ordering tended to prefer MAS over no treatment (OR (95% CI): 1.87 (1.09, 3.22)).

The optimal option for 11 respondents could not be calculated since they indicated only one attribute to have any value. In the 510 remaining respondents, there was no difference between groups' calculated optimal treatment preferences (Table 2). In the conventional group, the calculations suggested that respondents should prefer MAS more than they indicated (51% vs 41%) and should prefer no treatment less (18% vs 29%).

In the conventional group, 70% of respondents chose the option that was calculated to be optimal. In the recency group, this was improved to 78% (OR (95% CI): 1.43 (0.88, 2.32), p=0.15), and in the primacy group, this was improved to 90% (OR (95% CI): 3.88 (2.10, 7.20), p<0.001) (Table 2).

Figure 3 shows the proportion of respondents with concordant choices by age and education. The impact of primacy effects on concordance is significantly higher in younger people than in older people (OR (95% CI): 8.05 (2.93, 22.13) vs 2.09 (0.92, 4.74), p=0.042). A small non-significant trend was identified with higher educated respondents being slightly more concordant than lower educated respondents.

3.3 Decisional conflict

Decisional conflict in the clarity of values and uncertainty subscales was high for all groups. While the scores were lower in both ordered groups, this was not by statistically significant difference (Table 3).

4. Discussion and Conclusion

4.1 Discussion

This study identified that individuals are more likely to make treatment choices that reflect their values when the information presented in a PtDA is ordered according to their informed preferences.

We found a significant primacy effect whereby respondents were more likely to choose the treatment option calculated to be best for them if they were presented first with information about the attributes they felt were personally important. This effect was identified to be most prominent in younger individuals.

An interesting finding was that primacy, rather than recency, effects had a greater influence on decisions. Primacy effects occur since items early in a list have a memory advantage. This advantage is due to the first items in a list having less competition for limited memory capacity.[24] Existing research suggests that position effects extend beyond memory and may influence actual behaviour. For example, subjects tended to view and choose ads in the Yellow Pages that were at the top of the alphabetical list[13] and choose candidates listed at the top of electoral ballots.[25] Research in economics points to a warm (or fading) glow effect in the way information influences people's values,[26] which can go on to influence peoples choices.[27,28] There is limited evidence on the influence of order effects in the design of health education materials, despite a recognition that such cognitive biases can impact people's ability to process content-related information.[29] Feldman-Stewart found that the order of 57 different questions about treatments for ovarian cancer accounted for up to 21% of the variance in participants' judgments regarding which treatments for the disease were important.[30] Ubel identified a recency effect whereby women at high risk of breast cancer who learned first about the risks of tamoxifen prophalyxis therapy remembered the benefits of tamoxifen better and thought more favourably of the drug in comparison to women who learned first about the benefits.[15] We speculate that the influence of order effects will be greater in PtDAs with greater numbers of attributes. We also predict that primacy vs recency effects will differ depending on list length and where in the PtDA the patient is asked their treatment preference. Future studies exploring different designs with both fewer and greater numbers of attributes should further examine the influence of both primacy and recency effects.

We found that younger people (≤35) were more influenced by the primacy effect, which could be because this group has preformed habits for reading web pages. Studies of web browsing have found that older users are more likely to read all of the information on a screen before committing themselves to move to the next screen.[31] Younger users are more likely to read less of the on-screen information on a web page, often reading the top line and then scanning vertically down the left of the page.[31] If this phenomenon is also present with web based PtDAs, it is plausible that younger people are more influenced by order effects.

A specific strength of this study is the randomized experiment used to detect differences between PtDA designs. Despite over 86 randomized trials of PtDAs,[32] few have used randomization to examine the influence of design issues. The majority of those few studies considered the influence of individualized risk estimates and found only limited impact.[30] This study contributes to the small literature researching the effect of information design on decision-making.

Our results should be interpreted with caution given certain study limitations. First, the task was hypothetical and so we cannot be sure that the results observed would also be found among sleep apnea patients making actual treatment decisions. If this experiment was not hypothetical, it is quite plausible that patients would spend more time studying the information provided and be less influenced by order effects as a result. Consequently, it is possible the size of effects may be an overestimate of what would happen in clinical practice. The study by Ubel et al did however find small order effects among women at a high risk of breast cancer who used a PtDA on preventative therapy options. Thus while the effects we observed might be reduced, they are unlikely to be eliminated if our study were replicated with a sample of sleep apnea patients.[15]

Second, the results could have been confounded by the order in which we presented the value clarification exercise and treatment option information. Most PtDAs require patients to clarify their values after they read the treatment information and just before they select a preferred option, as in Group 1. We are unable to determine whether providing the value clarification first, as was done in Groups 2 and 3, led to improved decision quality, independent of the order effects.

Third, while using Mechanical Turk as a recruitment method enabled us to enrol a fairly large sample in spite of limited study resources, the method raises some concerns about sample representativeness and data quality.[23] Turkers are more likely to be younger than the general population, female, and have a lower income.[33] They therefore do not reflect the characteristics of sleep apnea patients. In terms of quality, we had to exclude 5% of the sample for not reading and understanding the treatment information correctly. Otherwise, we believe our data quality reasonably reflects that of other studies.[34]

Fourth, our use of MCDA to ascertain the optimal option for each individual relies on certain assumptions.[35] We chose MCDA because it is a simple approach for individuals to use in deciding between options. While we assume that some treatments are suboptimal, we acknowledge that these options actually may be optimal for some individuals.

Finally, we could have increased our ability to identify order effects if we had used a PtDA for a more complex treatment decision. Over 70% of individuals were able to select the optimal option using a fixed order, which leaves limited room for improvement. Future studies should focus on decisions where individuals tend to make poor judgments.

4.2 Conclusion

Harnessing the influence of order effects and individualizing the way health information is presented may help patients make better quality decisions. While the effects we observed are relatively small, order effects can be implemented at little cost, particularly as web/computer based PtDAs are becoming indispensable for delivering individualized risk estimates and communicating patient stories.[36]. This study contributes to a growing literature demonstrating that developers of static PtDAs may have unintentional but important influences on which options patients choose.

This work represents one example of using behavioural design to help individuals overcome cognitive errors. Other strategies to overcome position effects have included methods to debias health information, such as through use of pictographs or incremental risk information.[15] However, these approaches typically require individuals to view even more information, making them susceptible to other biases such as information overload.[37] One promising approach for improving patient decision-making is through exploiting cognitive biases or by using so called 'nudges' – "aspect[s] of the choice architecture that alter people's behavior in a predictable way without forbidding any options or significantly changing their economic incentives."[5] While there is an awareness of the influence of PtDA design on choices,[38–40] few studies to date have used nudges.[41] Additional approaches exist, such as tailored default options and providing feedback,[42-43] and should be the focus of future research.

4.3 Practise implications

When PtDAs are tailored to individuals, the focus has predominantly been on individualizing risk estimates.[44] This study focusses on individualizing the presentation of health information. This is important as it can still be challenging for well-informed patients to make trade-offs when using PtDAs. Developers of decision support materials should consider the influence of order effects on how patients make these trade-offs and the options they choose. While approaches exist to debias these effects, the alternative approach we explored in this study was to exploit order effects by helping patients focus on the treatment aspects that matter most to them. For web/computer based PtDAs, this is a relatively simple feature to employ. We urge PtDA developers to make it simpler for patients to make trade-offs between treatment characteristics. We also emphasize the need for additional research to help patients make choices that align with their values, recognizing the disproportionate amount of research currently focused on the knowledge component of decision-making.

Role of funding and conflict of interest

This project was funded by the Canadian Institutes of Health Research and the BC Lung Association. The funders were not involved in data collection, data analysis, interpretation, the decision to prepare this manuscript for publication, or the writing of this manuscript.

Acknowledgements

We acknowledge Huiying Sun for her review of the statistical analysis and Sarah Munro for her help in copy editing the manuscript. We are grateful for the participants who participated in the surveys. At the time of the conception of this work, Nick Bansback was supported by Postdoctoral Awards from the Canadian Arthritis Network and Pfizer Canada.

References

[1] O'Connor AM. Using decision aids to help patients navigate the "grey zone" of medical decision-making. Can Med Assc Jour 2007;176:1597–8.

[2] Charles C, Gafni A, Whelan T. Decision-making in the physician-patient encounter: revisiting the shared treatment decision-making model. Soc Sci Med 1982 1999;49:651–61.

[3] Sepucha KR, Borkhoff CM, Lally J, Levin CA, Matlock DD, Ng CJ, et al. Establishing the effectiveness of patient decision aids: key constructs and measurement instruments. BMC Med Inform Decis Mak 2013;13:S12.

[4] Feldman-Stewart D, O'Brien MA, Clayman ML, Davison BJ, Jimbo M, Labrecque M, et al. Providing information about options in patient decision aids. BMC Med Inform Decis Mak 2013;13:S4.

[5] Hibbard JH, Peters E. Supporting informed consumer health care decisions: Data Presentation Approaches that Facilitate the Use of Information in Choice. Annu Rev Public Health 2003;24:413–33.

[6] Todd P, Benbasat I. Inducing compensatory information processing through decision aids that facilitate effort reduction: An experimental assessment. J Behav Decis Mak 2000;13:91–106.

[7] Redelmeier DA, Rozin P, Kahneman D. Understanding patients' decisions. Cognitive and emotional perspectives. JAMA J Am Med Assoc 1993;270:72–6.

[8] Kahneman D, Tversky A, Foundation RS. Choices, values, and frames. Cambridge Univ Pr; 2000.

[9] Ebbinghaus H. Memory: A contribution to experimental psychology. Teachers college, Columbia university; 1913.

[10] Shteingart H, Neiman T, Loewenstein Y. The role of first impression in operant learning. J Exp Psychol Gen 2013;142:476.

[11] Haugtvedt CP, Wegener DT. Message Order Effects in Persuasion: An Attitude Strength Perspective. J Consum Res 1994;21:205–18.

[12] Trotman K, Wright A. Order effects and recency: Where do we go from here? Account Finance 2000;40:169–82.

[13] Lohse GL. Consumer eye movement patterns on yellow pages advertising. J Advert 1997;26:61–73.

[14] Schkade David A, Kleinmuntz Don N. Information displays and choice processes: Differential effects of organization, form, and sequence. Organ Behav Hum Decis Process 1994;57:319–37.

[15] Ubel PA, Smith DM, Zikmund-Fisher BJ, Derry HA, McClure J, Stark A, et al. Testing whether decision aids introduce cognitive biases: Results of a randomized trial. Patient Educ Couns 2010;80:158–63.

[16] Balk EM., Moorthy D, Obadan NO, Patel K, Ip S, Chung M, Bannuru RR et al. Diagnosis and treatment of obstructive sleep apnea in adults. Rockville (MD): Agency for Healthcare Research and Quality (US); 2011. (Comparative Effectiveness Reviews, No. 32.) Available from: http://www.ncbi.nlm.nih.gov/books/NBK63560/

[17] International Patient Decision Aids Standards (IPDAS) Collaboration. http://ipdas.ohri.ca/

[18] Almeida FR, Henrich N, Marra C, Lynd LD, Lowe AA, Tsuda H, et al. Patient preferences and experiences of CPAP and oral appliances for the treatment of obstructive sleep apnea: a qualitative analysis. Sleep Breath 2013;17:659–66.

[19] Eddy DM. Comparing benefits and harms: the balance sheet. J Am Med Assoc 1990;263:2493-98.

[20] O'Connor AM. User Manual - Decisional Conflict Scale 2010. Available from www.ohri.ca/decisionaid

[21] Dolan J. Multi-Criteria Clinical Decision Support: A Primer on the Use of Multiple-Criteria Decision-Making Methods to Promote Evidence-Based, Patient-Centered Healthcare. Patient Patient-Centered Outcomes Res 2010;3:229–48.

[22] O'Connor AM. Validation of a decisional conflict scale. Med Decis Making 1995;15:25–30.

[23] Paolacci G, Chandler J, Ipeirotis P. Running experiments on amazon mechanical turk. Judgm Decis Mak 2010;5:411–9.

[24] Norman DA, Waugh NC. Stimulus and response interference in recognition-memory experiments. J Exp Psychol 1968;78:551.

[25] Koppell JG, Steen JA. The effects of ballot position on election outcomes. J Polit 2004;66:267–81.

[26] Kahneman D, Knetsch JL. Valuing public goods: the purchase of moral satisfaction. J Environ Econ Manag 1992;22:57–70.

[27] Kjær T, Bech M, Gyrd-Hansen D, Hart-Hansen K. Ordering effect and price sensitivity in discrete choice experiments: need we worry? Health Econ 2006;15:1217–28.

[28] Stewart JM, O'Shea E, Donaldson C, Shackley P. Do ordering effects matter in willingness-to-pay studies of health care? J Health Econ 2002;21:585–99.

[29] Wilson E, Wolf M. Working memory and the design of health materials: a cognitive factors perspective. Patient Educ Couns 2009;74(3):318–322.

[30] Feldman-Stewart D, Chammas S, Hayter C, Pater J, Mackillop WJ. An empirical approach to informed consent in ovarian cancer. J Clin Epidemiol 1996;49(11):1259–69.

[31] Djamasbi S, Siegel M, Tullis T. Generation Y, web design, and eye tracking. Int J Hum-Comput Stud 2010;68:307–23.

[32] Stacey D, Bennett CL, Barry MJ, Col NF, Eden KB, Holmes-Rovner M, et al. Decision aids for people facing health treatment or screening decisions. Cochrane Database Syst Rev 2011.

[33] Winter M, Suri S. Conducting behavioral research on Amazon's Mechanical Turk. Behav Res Methods 2012;44.1 2012: 1-23.

[34] Buhrmester M, Kwang T, Gosling SD. Amazon's Mechanical Turk A New Source of Inexpensive, Yet High-Quality, Data? Perspect Psychol Sci 2011;6:3–5.

[35] Russell LB, Schwartz A. Looking at Patients' Choices through the Lens of Expected Utility A Critique and Research Agenda. Med Decis Making 2012;32:527–31.

[36] Hoffman AS, Volk RJ, Saarimaki A, Stirling C, Li LC, Härter M, et al. Delivering patient decision aids on the Internet: definitions, theories, current evidence, and emerging research areas. BMC Med Inform Decis Mak 2013;13:S13.

[37] Peters E, Dieckmann N, Dixon A, Hibbard JH, Mertz CK. Less Is More in Presenting Quality Information to Consumers. Med Care Res Rev 2007;64:169–90.

[38] O'Connor AM. Effects of framing and level of probability on patients' preferences for cancer chemotherapy. J Clin Epidemiol 1989;42:119–26.

[39] O'Connor AM, Pennie RA, Dales RE. Framing effects on expectations, decisions, and side effects experienced: the case of influenza immunization. J Clin Epidemiol 1996;49:1271–6.

[40] Amsterlaw J, Zikmund-Fisher BJ, Fagerlin A, Ubel PA. Can avoidance of complications lead to biased healthcare decisions. Judgm Decis Mak 2006;1:64–75.

[41] Blumenthal-Barby JS, Cantor SB, Russell HV, Naik AD, Volk RJ. Decision Aids: When "Nudging" Patients To Make A Particular Choice Is More Ethical Than Balanced, Nondirective Content. Health Aff (Millwood) 2013;32:303–10.

[42] Boyce T, Dixon A, Fasolo B, Reutskaja E. Choosing a high-quality hospital. The role of nudges, scorecard design and information. The King's Fund. 2010. www.thekingsfund.com.

[43] Carrigan N, Gardner PH, Conner M, Maule J. The impact of structuring information in a patient decision aid. Psychol Heal 2004;19:457–77.

[44] Kreuter MW, Skinner CS. Tailoring: what's in a name? Health Educ Res 2000;15:1–4.

Table and Figures with legends

Table 1: Demographic information

Table 2: Proportion of respondents' optimal and selected treatments, and calculated concordance

MAS= Mandibular Advancement Splint

CPAP= Continuous Positive Airway Pressure

a. The option the respondent selected they preferred
b. The option calculated to have the highest weighted score from MCDA exercise from each individual's values and scores
c. Where the option selected equalled the optimal option

† Adjusted for age, sex, and education

Table 3: Decisional Conflict outcomes

Adjusted for age, sex, and education

Figure 1: Design

Figure 2: Proportion of respondents with concordant choices by key demographics

*The OR of Primacy vs Conventional is significantly greater than 1 at the 5% level.

Highlights

We ask hypothetical patients to choose between treatment options

We examine the impact of order effects on information about treatments on choices

Ordering information in accordance to patient priorities influences decisions

Presenting most important information first led to most improved decisions

Implications for designers of patient education tools discussed

Table 1: Demographic information

	Group 1: Conventional (n=164)	Group 2: Recency (n=186)	Group 3: Primacy (n=171)	Total (n=521)
Gender, n (%)				
Female	103 (63)	116 (62)	99 (58)	318 (61)
Male	61 (37)	70 (38)	72 (42)	203 (39)
Age, n (%)				
≤25	24 (15)	26 (14)	23 (13)	73 (14)
26-35	62 (38)	68 (37)	61 (36)	191 (37)
36-45	23 (14)	23 (12)	20 (12)	66 (13)
46-55	26 (16)	34 (18)	32 (19)	92 (18)
≥56	29 (18)	35 (19)	35 (20)	99 (19)
Highest education, n (%)				
High school or less	13 (8)	13 (7)	19 (11)	45 (9)
Some college	59 (36)	57 (31)	47 (27)	163 (31)
College degree	54 (33)	71 (38)	59 (35)	184 (35)
Above college degree	38 (23)	45 (24)	46 (27)	129 (25)
Average values (%)				
Efficacy	33%	35%	35%	34%
Comfort	16%	15%	17%	16%
Side-effects	5%	4%	3%	4%
Practicality	6%	8%	7%	7%
Partner considerations	14%	13%	14%	14%
Cost	26%	26%	23%	25%

Table 2: Proportion of respondents optimal and selected treatments, and calculated concordance

	Group 1: Conventional (n=164)	Group 2: Recency (n=186)	Group 3: Primacy (n=171)	ORs (95% CI)	
				Grp 2 vs Grp 1	Grp 3 vs Grp 1
Selected[a]	N=164	N=186	N=171		
No Treatment	29%	30%	20%	Ref	Ref
CPAP	30%	26%	28%	0.87 (0.50, 1.52)	1.38 (0.76, 2.50)
MAS	41%	44%	52%	1.07 (0.65, 1.77)	1.87 (1.09, 3.22)
Total	100%	100%	100%		
Optimal[b]	N=162	N=180	N=168		
No Treatment	18%	23%	15%	Ref	Ref
CPAP	30%	25%	27%	0.69 (0.37, 1.27)	1.08 (0.56, 2.10)
MAS	51%	51%	54%	0.81 (0.46, 1.41)	1.29 (0.71, 2.36)
Total	100%	100%	100%		
Concordance[c]	N=162	N=180	N=168		
Total	70%	78%	90%	1.43 (0.88, 2.32)†	3.88 (2.10, 7.20)†

MAS= Mandibular Advancement Splint

CPAP= Continuous Positive Airway Pressure

a. The option the respondent selected they preferred
b. The option calculated to have the highest weighted score from MCDA exercise from each individuals values and scores
c. Where the option selected equalled the optimal option

† Adjusted for age, sex and education

Table 3: Decisional Conflict outcomes

	Group 1: Conventional (n=164)	Group 2: Recency (n=186)	Group 3: Primacy (n=171)	P – value	
				Grp 2 vs Grp 1	Grp 3 vs Grp 1
Clarity of Values	66.36 (26.11)	62.63 (27.58)	60.77 (28.09)	0.20	0.06
Uncertainty	61.23 (32.01)	59.09 (30.14)	56.33 (32.29)	0.52	0.16

Figure 1: Design

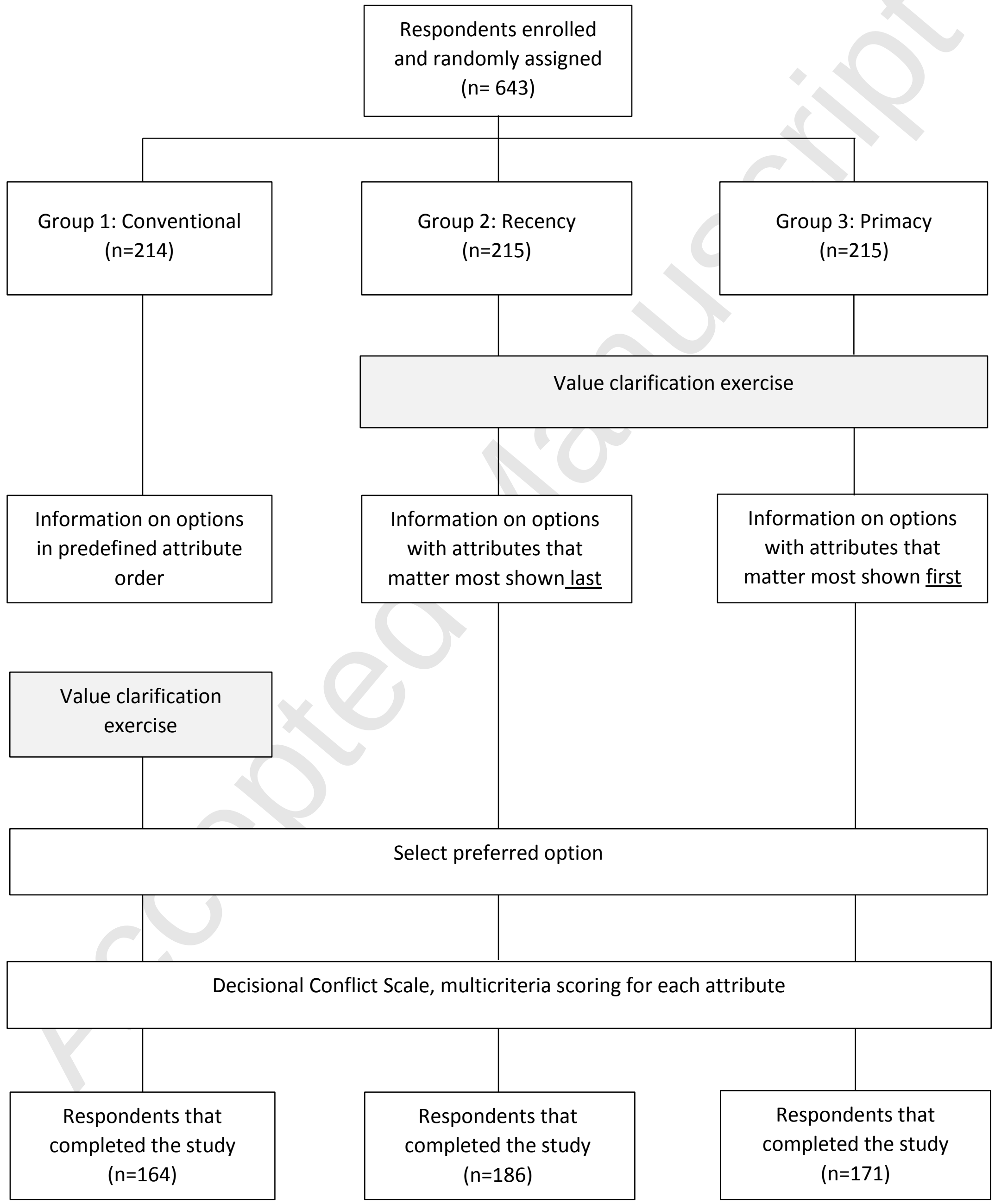
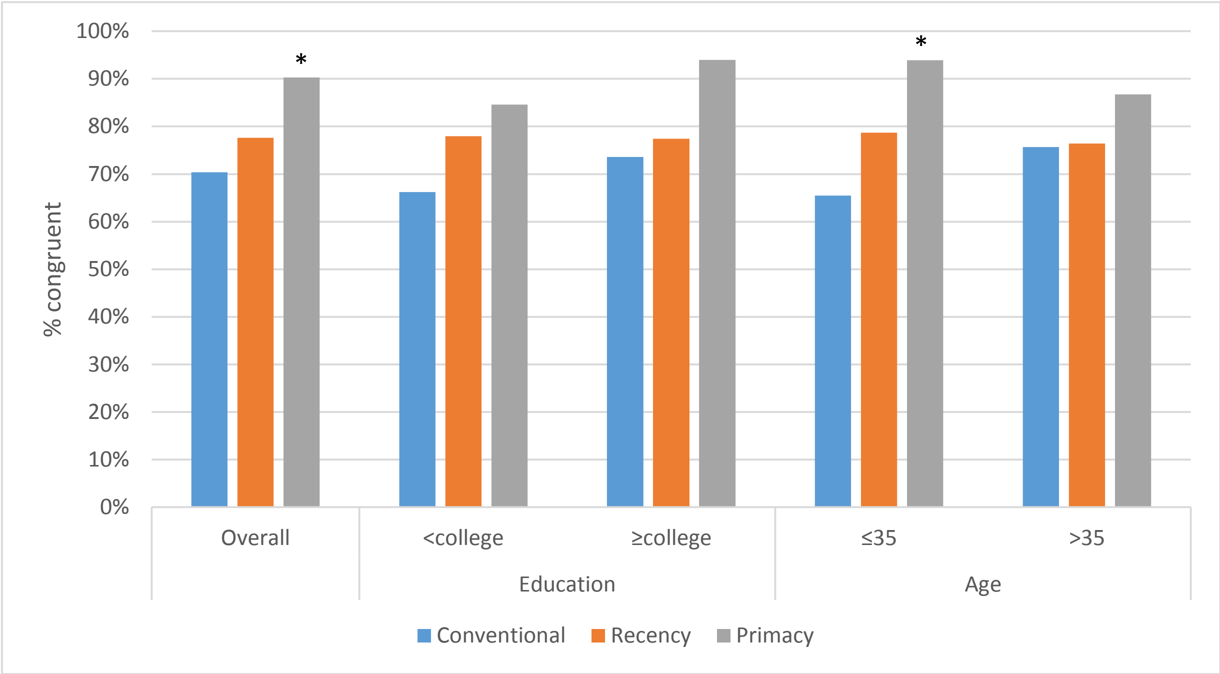


Figure 2: Proportion of respondents with concordant choices by key demographics



*The OR of Primacy vs Conventional is significantly greater than 1 at the 5% level.