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<https://www.magonlinelibrary.com/doi/abs/10.12968/bjom.2020.28.1.34>

Title: The influence of women's cognitive status on their understanding of Down syndrome screening information and midwife communication

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Abstract

Aims: To establish whether women's cognitive status influenced their understanding of Down syndrome screening information and to determine whether midwives offer the same oral explanation of Down syndrome screening to all women or if information was tailored to each woman based on their cognitive status.

Methods: Midwives (n=16) and women (n=100) were recruited from a regional National Health Service (NHS) unit in the United Kingdom (UK). A mixed methods design encompassed two components; audio-recorded antenatal consultations and quantitative surveys to assess women's cognitive status and their understanding of Down syndrome screening information.

Findings: Whilst women with abstract reasoning skills and high Need for Cognition could understand information sufficiently, women with more concrete skills and low Need for Cognition require further explanation from the midwife to reach an informed decision.

Conclusions: Midwives did not tailor their communication based on women's cognitive status, however if they had, all women should have left appointments well informed. This has implications for midwifery education programmes to train midwives to communicate Down syndrome screening information effectively.

Key phrases

- Cognitive status influences women's understanding of Down syndrome screening information.

- Women's abstract reasoning and high Need for Cognition resulted in informed decision-making.
- Women's concrete reasoning and low Need for Cognition resulted in uninformed decision-making.
- Midwives did not tailor Down syndrome screening information to individual women.

1. Introduction

The booking appointment is the first antenatal appointment a woman has with her midwife. At this appointment women are offered screening for numerous conditions including Down syndrome (DS). It is vital that women understand screening information because of the implications of the decisions they make. However, research has documented that women are not making informed decisions and undergo screening not realising the implications and subsequent decision-making required (Hall et al. 2009; Bangsgaard and Tabor, 2013). This research aimed to investigate what factors influence women's understanding of DS screening information.

Cognitive status plays a role in how we process information in the world around us, consequently it may influence women's understanding of screening information. Cognitive ability encompasses a set of mental processes, including attention, memory, intelligence, problem solving, and reasoning.

Piaget (1972) proposed a theory of cognitive development from childhood to adulthood and distinguished between concrete and abstract thought. As humans age their cognitive development becomes increasingly abstract and logical. Concrete

terms and items, which are observable, tend to be acquired at an earlier age than abstract terms, which are not observable (Rosa et al. 2010). Abstract thinking forms the basis of logic (Tennant, 2005) and allows individuals to solve problems correctly by imagining alternative solutions (Stern and Prohaska, 1996) and apply knowledge to novel situations (Campbell and Ritchie, 2002). The speed of cognitive development can vary between individuals (Piaget, 1972), and it has been suggested that some adults may never gain abstract reasoning (Keating, 1979; Cole, 1990; Lehman and Nisbett, 1990) and abstract thought might only manifest itself in particular activities in which their strengths lie (Lehman and Nisbett, 1990; Goldwater and Gentner, 2015).

The capacity to solve novel problems in unfamiliar settings is essential for success in everyday situations (Matthew and Stemler, 2013). Within a booking appointment, women are presented with new, and sometimes complex, information which requires reasoning skills to understand it. Abstract reasoning can be assessed by verbal and non-verbal reasoning since learning relies on the ability to process both linguistic and perceptual information (Rosa et al. 2010). Verbal reasoning is the ability to understand problems or ideas framed using words, whereas non-verbal reasoning is the ability to solve problems visually, such as identifying relationships or sequences between patterns. Individuals with non-verbal reasoning skills possess abstract reasoning ability (Coaley, 2009).

Abstract and concrete reasoning can be placed on a continuum where levels of “abstractness” can be measured (Wiemer-Hastings et al. 2001). Within this study, women who have high abstract cognitive status are expected to have a better understanding of DS screening information. This could have implications for

midwifery guidelines where women with more concrete reasoning skills will need to be identified and supported to ensure that they make informed decisions.

Need for Cognition (NfC)

NfC is “the tendency for an individual to engage in and enjoy thinking” (Cacioppo and Petty, 1982, p.116) and is a form of cognitive motivation which relates to the extent that people engage in thinking to increase their knowledge (Cohen et al. 1955; Haugtvedt et al. 1992). Individuals with high NfC are more likely to be active in discussions, enjoy critical thinking, seek information and ask questions than those with low NfC (Cacioppo et al. 1996; Barbaro et al. 2015). Individuals with low NfC find little enjoyment in exerting cognitive effort, only think as hard as they have to and may avoid situations that involve a lot of thought (Gray et al. 2015). Individuals can fall anywhere on the distribution of low to high NfC (Petty et al. 2009).

Tailoring communication

Information may be tailored by the midwife to suit each woman’s cognitive requirements. Patient education is often unsuccessful and it has been suggested that this is due to health professionals’ inability to tailor information (Adams et al. 2009). A “one-size-fits-all” approach is insufficient and information should be individualised to suit each individual’s requirements (Kreuter et al. 1999; Potter et al. 2015).

In Australia, Wilmore and colleagues (2015) interviewed antenatal staff (n=21) and found that midwives did not feel they have enough time in an appointment to gain an understanding of women’s education level and skills, consequently their tailoring was inconsistent.

Another challenge, other than time, is that each woman has different information needs to gain sufficient understanding (Bensing et al. 2013; Hewison, 2015). Some women require specific information such as facts and figures (Harper, 2004) whereas others have expressed feeling over-informed (Carolan, 2007) and are happy with brief, accurate information (Hargreaves et al. 2005; Davis et al. 2006). If too much information is presented, key information, such as risk messages, may be overlooked (Potter et al. 2015). Midwives (n=16) and women (n=100) were recruited from a regional National Health Service (NHS) unit in the United Kingdom (UK). Clients themselves have expressed a preference for tailored information (DoH, 2010; Martin et al. 2013).

Whilst health professionals may tailor information based on women's cognitive status, women themselves may influence midwife communication. For instance, individuals with high NfC are more likely to be more active in discussions, ask questions and speak for longer than those with low NfC (Shestowsky and Horowitz, 2004; Barbaro et al. 2015). When questions are asked, health professionals provide more information (Cegala et al. 2007).

This is the first study of its kind; cognitive status, in terms of abstract-concrete reasoning (Piaget, 1972) and NfC (Cacioppo and Petty, 1982), has not previously been investigated as an influence on how women understand DS screening information. Furthermore, it has not been considered as a factor that could influence the midwife's presentation of information. Whether midwives tailor oral DS screening information in booking appointments, or whether they offer rote or 'favourite' explanations, is unknown.

2. Methods

Design

The study employed a mixed methods approach; audio-recording and transcribing consultations to capture midwife communication and questionnaires were administered to assess women's demographics, cognitive status and their understanding of the presented DS screening information.

Study participants

Midwives (n=16) and women (n=100) were required to satisfy inclusion criteria to be considered for the study. Midwives were required to be registered and employed by the Health Board in NHS Wales; providing booking appointment services to women where antenatal screening options are discussed; be English speaking in accordance with the requirements of the employer.

Women were included if they made their booking appointments with participating midwives, were over the age of 16 years, had capacity to consent and had adequate understanding of verbal and written communication in English.

Data collection

Midwives were sent an email containing invitation letters, information sheets and consent forms. Consenting midwives sent invitation letters, information sheets and consent forms to women who met the inclusion criteria and made their booking appointment with them.

When consenting women attended their booking appointments audio-recording was initiated and then the researcher withdrew. Only the information provided on DS screening was transcribed and analysed. Once the booking appointment was complete, women completed a questionnaire.

Data analysis

Audio-recordings were transcribed and five different aspects of midwife communication were measured (table 1). The new Measuring Understanding of Screening Information and Communication (MUSIC) framework has been used in a parallel study ([Reference Paper 1](#)) that discusses midwife communication further.

The questionnaire included multiple-choice questions regarding DS screening information that would normally be covered in a booking appointment to assess women's understanding of provided information. A range of closed and open questions were utilised to gather demographics.

Verbal reasoning was assessed using five proverbs from Gorham's standardised "Best Answer" proverb interpretation test (Gorham, 1956). Correct interpretation of a proverb demonstrates good reasoning skills (Gibbs Jr and Beitel, 1995; Gibbs Jr, 2001). Individuals who have not developed abstract reasoning skills are likely to provide concrete answers to proverbs (Stern and Prohaska, 1996). If individuals are unfamiliar with a proverb this truly tests their abstract reasoning skills. Therefore, women's familiarity with the proverbs was established. Whilst proverbs can provide an overall view of individuals' ability on the abstract-concrete continuum (Campbell and Ritchie, 2002), on their own, correct interpretation of proverbs typically does not lead to definitive conclusions regarding individuals' higher cognitive ability (Campbell and Ritchie, 2002). Therefore, they should be accompanied by non-verbal reasoning tests.

Ravens Standard Progressive Matrices (RSPM) were used to assess women's non-verbal abstract reasoning skills (Raven, 1938). The RSPM involve visual-spatial processing where participants choose missing elements from options provided, to

complete a pattern. The original matrices consist of sixty items with five sets containing twelve items each. Each set represents a different conceptual theme and increases in difficulty (Ramsey and Wright, 1968), therefore, each set requires a different thought process (Jones, 2010). Due to time constraints and attrition concerns, a shorter nine item version was employed which has the same predictive power, reliability and validity as the sixty item matrices (Bilker et al. 2012).

Cacioppo et al. (1984) developed a scale to assess NfC which was utilised within this research. The scale was tested on different populations and reported a reliability coefficient of $\alpha=0.90$ (Cacioppo et al. 1996). The scale has high internal consistency and test-retest reliability (Petty et al. 2009).

A demographics section was included within the questionnaire to ascertain whether women's understanding and cognitive status was related to their demographics.

Table 1: Measures used to assess midwife communication of DS screening information within antenatal booking appointments

Communication Measures									
Language	Number: Word count and sentences								
Complexity	<p>Average: Sentences per paragraph, Words per sentences</p> <p>Readability: Passive Sentences, Flesch Reading Ease and Flesch-Kincaid Grade Level. Passive sentence measures how informative text is; the higher the score the more complex and formal the text. The higher the score on the Flesch Reading Ease the easier the text is to understand:</p> <table border="1"> <thead> <tr> <th>Score</th> <th>Difficulty</th> </tr> </thead> <tbody> <tr> <td>0-40</td> <td>Very difficult – Difficult</td> </tr> <tr> <td>40-80</td> <td>Average</td> </tr> <tr> <td>80+</td> <td>Easy – Very Easy</td> </tr> </tbody> </table> <p>Flesch-Kincaid Grade Level should aim for a score of 4.0-5.0</p> <p>Technical terminology score: If any of the following eight words were used in the appointment it was noted whether the midwife provides an explanation of these words or not: Diagnostic, Amniocentesis, Amniotic, Screening, Chromosome, Abnormalities, Millilitres, Obstetrician</p>	Score	Difficulty	0-40	Very difficult – Difficult	40-80	Average	80+	Easy – Very Easy
Score	Difficulty								
0-40	Very difficult – Difficult								
40-80	Average								
80+	Easy – Very Easy								
Dynamics	Interactivity: Number of speaking turns in a session per minute								

Pace: Average number of syllables per word x total transcript word count/session length (in seconds)

Duration: Average duration in seconds spanning a block of uninterrupted speech

Check knowledge/ understanding Knowledge check: Do midwives check women's current knowledge levels when they commence the appointment
Understanding check: Do midwives check that women understand the information throughout the appointment. How do midwives check understanding, do they explicitly ask or use paraphrasing

Resources Are additional resources used to aid explanations, e.g. pictograms

Abstract Language The Linguistic Category Model (LCM): The higher the score the more abstract the text. Four word categories are distinguished to produce an 'abstract score', computed as follows:

Word Type	Score
Descriptive Action Verbs (e.g. yell, hit, walk)	1
Interpretative Action Verbs & State Action Verbs (e.g. help)	2
State Verbs (e.g. to think, admire, hate, appreciate)	3
Adjectives (e.g. social, aggressive, honest, reliable)	4

Questionnaire responses were entered into Statistical Package for the Social Sciences (SPSS) version 23. Descriptive statistics were used to analyse demographics. Pearson's correlation and enter method multiple regression analysis were used to answer research questions. T-tests and ANOVA analyses were conducted to investigate any differences in women's cognitive ability and understanding of DS screening information depending upon their demographics or characteristics.

Ethics

Ethics approval was granted from the Faculty of Life Sciences and Education the National Research Ethics Service Committee South Central Berkshire (15/SC/0187) and NHS Research and Development (142651).

3. Findings

Demographics

The age of women ranged from 17-42 with an average age of 27.6 years. One woman did not provide her age. Whilst women's verbal reasoning (proverbs score) and NfC significantly positively correlated with their age, women's non-verbal reasoning (RSPM score) and age were not correlated. Age accounted for 14.9% variance in women's understanding.

The number of years women spent in education ranged from 7 to 25 years with an average of 14 years. Five women were currently in education, another woman stated that she was last in education 20 years ago, the average amount of time women had been out of education was 7.7 years. Three women left this question blank.

There was a significant positive correlation between the number of years women spent in education and their understanding of DS screening information ($r=0.229$, $n=96$, $p<0.05$) thus more educated women had a better understanding of DS screening information. The number of years women spent in education accounted for 5.2% of the variance in women's understanding of DS screening information.

There was not a significant correlation between the number of years women spent in education and their verbal reasoning or non-verbal reasoning. However, a significant positive correlation was evident between the number of years women spent in education and their NfC score ($r=0.267$, $n=96$, $p<0.01$).

The number of years since women left education was not significantly related to women's understanding or cognitive ability.

Of the 80% of women sampled who had obtained their GCSE English Language the majority obtained grade C. Nine participants did not complete this question. An

independent samples t-test revealed that women who had obtained their GCSE English had a significantly higher mean DS understanding score ($M=7.15$, $S.D=2.063$) than those who had not obtained their GCSE English ($M=5.16$, $S.D=2.243$) ($t(97)=3.722$, $p<0.01$). Women who obtained GCSE English language had significantly higher verbal reasoning ($M=6.65$, $S.D=2.176$) than those who did not obtain their GCSE English ($M=4.39$, $S.D=2.304$), ($t(96)=3.94$, $p<0.01$). There was also a significant difference for women's NfC for those who did ($M=57.3$, $S.D=10.924$) and did not ($M=43.16$, $S.D=11.654$) achieve GCSE English ($t(97)=5.013$, $p<0.01$).

Cognitive status

Verbal reasoning

A significant moderate positive correlation was found between Proverbs score and women's understanding ($r=0.49$, $n=99$, $p<0.01$). Verbal reasoning accounted for 24% of variance in women's DS understanding. There was not a significant correlation between proverbs score and familiarity.

Non-verbal reasoning

A significant positive correlation was evident between women's non-verbal reasoning and their understanding of DS information ($r=0.317$, $n=100$, $p<0.01$). Non-verbal reasoning accounted for 10% of the variance in women's DS screening understanding.

There was a significant positive correlation between women's cognitive ability overall and their understanding of DS screening information.

Need for Cognition

A moderate significant positive correlation between NfC and understanding of DS screening information was evident ($r=0.398$, $n=100$, $p<0.01$). NfC accounted for 15.9% of the variance in women's understanding.

Using enter method regression it was found that women's cognitive status explained a significant amount of the variance in their understanding of DS screening information ($F(3,95)=14.501$, $p<0.01$, $r^2=0.314$, $r^2_{\text{Adjusted}}=0.292$). Women's verbal reasoning skills (Proverbs score, $\text{Beta}=0.371$, $t=3.959$, $p<0.01$) and NfC ($\text{Beta}=0.193$, $t=2.014$, $p<0.05$) made significant unique contributions to the prediction of the outcome (women's understanding) with verbal reasoning contributing most to the outcome. Women's non-verbal reasoning (RSPM score) did not make significant unique contributions to the prediction of the outcome ($\text{Beta}=0.175$, $t=1.949$, $p>0.05$).

Pearson's correlation coefficient was computed to assess the relationship between women's NfC and their abstract-concrete reasoning score. There was significant positive correlation between each of the measures of cognitive status; Proverbs and RSPM ($r=0.229$, $p<0.01$, $n=99$), Proverbs and NfC ($r=0.408$, $p<0.01$, $n=99$), RSPM and NfC ($r=0.301$, $p<0.01$).

Overall, women's proverbs score accounted for the most variance in their understanding of DS screening information.

Tailoring information

Midwives did not alter their language complexity ($r=-0.148$, $p>0.05$, $n=99$, dynamics ($r=-0.132$, $p>0.05$, $n=99$) or abstract language ($r=-0.005$, $p>0.05$, $n=99$) based on women's verbal reasoning. However, there was a significant negative correlation between the number of times midwives assessed women's knowledge/understanding and women's proverb score ($r=-0.224$, $n=99$, $p<0.05$).

No significant multiple regression results were found for any of the communication measures against women's verbal reasoning, non-verbal reasoning or NfC.

4. Discussion

Cognitive status

Verbal reasoning

Women with more abstract verbal reasoning skills had a better understanding of DS screening information. Proverb interpretation and familiarity were not related therefore, correct interpretation of the proverb was reliant upon abstract interpretation and cognitive ability since the proverb requires additional processing beyond what is required to understand a familiar proverb (Gibbs Jr and Beitel, 1995).

Individuals' characteristics can influence their interpretation of proverbs, and women who had spent longer in education had enhanced proverb interpretation, supporting earlier findings (Nippold et al. 1997; Wachholz and Yassuda, 2011). It is difficult to assess whether higher education leads to superior abstract reasoning skills or whether advanced abstract skills allow individuals to reach higher levels of education. Individuals with higher levels of general intelligence "g" are usually better at understanding health information due to their increased capacity for reasoning and problem solving (Gottfredson, 2004; Der et al. 2009).

As would be expected, women who had obtained their GCSE English had higher abstract verbal reasoning. Women's age also had a significant influence on their proverb interpretation. As women's age increased their verbal reasoning and NfC also significantly increased. This is in line with previous findings where, as age increased, an increased performance on vocabulary tasks was also evident (Schroeder and Salthouse, 2004).

Non-verbal reasoning

On average, half of the questions on the RSPM were answered abstract and women with higher non-verbal abstract reasoning had a better understanding of the DS screening information. Psychologists have highlighted that choosing incorrect answers in the matrices could be caused by a number of different errors: individuals may not use all the information available, individuals use alternate reasoning to that required by the problem, individuals cannot distinguish between relevant and irrelevant features of the pattern and instead combine many features of each pattern, individuals choose a pattern that has already been presented (Jones, 2010).

Need for Cognition

Each individual has different drives to gain new information. In line with this, women's NfC was significantly associated with their understanding of DS screening information.

Older women and those who had spent more years in education had a significantly higher NfC. This is possibly because individuals with high NfC are more likely to seek further education to increase their knowledge. Women with higher NfC were also significantly more likely to obtain their GCSE English.

As predicted, there was a significant positive relationship between women's cognitive status and their NfC supporting the view that the best predictor of abstract reasoning skills, is NfC (Stuart-Hamilton and McDonald, 2001; Parry and Stuart-Hamilton, 2010). The higher women's abstract score on the reasoning measures the higher their NfC score, the lower women's abstract score the lower their NfC score.

RSPM are a good test of Spearman's "g" general intelligence (Raven, 2000). However women's verbal reasoning contributed most to the variability in women's

understanding of DS screening information. Therefore, this finding implies that women's intelligence is not accountable for their understanding of DS screening information. Women require sophisticated abstract verbal reasoning skills to interpret information provided by the midwife. Thus, midwives should not stereotype women based on their perceptions of how intelligent women are as this is not predictive of how well they will understand DS screening information. What is concerning from these findings is that women with more concrete cognitive status and lower NfC were leaving appointments not fully informed although they had made decisions to accept or reject screening.

Tailoring information

Midwives did not display different communication methods when faced with women of different non-verbal reasoning and NfC abilities. Although, midwives checked women's knowledge/understanding less for women who had higher verbal reasoning skills. This may be because they recognised that these women had a better understanding due to their advanced verbal skills and did not feel the need to assess their knowledge/understanding as much as women who had lower verbal reasoning skills.

Tailoring information may be difficult for midwives to achieve when they have not met the woman previously. The challenge of these findings is to find an approach whereby the midwives could assess women's cognitive status quickly in order to tailor information appropriately.

Overall, both the age and ethnicity of women included in this research does not generalise to the wider pregnant population. Therefore care must be taken with generalising findings and a larger study is required.

5. Conclusion

It is important that midwives are sensitive to individuals differing cognitive abilities and information requirements. This has implications for midwifery education and for service provision in terms of time available within booking appointments to sufficiently discuss and tailor DS screening information. The ability to tailor information is a challenge for midwives, other healthcare providers and communication researchers (Bensing et al. 2013), since each individual has different needs. Core midwifery concepts need to be taught in combination with communication skills. In cases where midwives have sufficient knowledge of genetics and screening, they may not have received training to communicate this information effectively.

The research extends the field by being the first study to introduce cognitive status as a significant influence on women's understanding of DS screening information. Whilst the study had limitations, this does not lessen the importance of the finding that women with more concrete cognitive ability and low NfC were not making well-informed decisions. Whilst women with abstract reasoning skills could understand information sufficiently, women with more concrete skills require further explanation from the midwife in order to reach an informed decision. The role that abstract reasoning and NfC plays has been outlined and these findings could be developed to contribute to a more informed approach to screening.

Acknowledgements: Thank you to the University of South Wales for funding the research via a doctoral scholarship. The authors wish to acknowledge the support of those midwives who helped us to recruit women for the study. In particular, thank

you to study advisors Debbie Lucey and Nicola Ralph for so generously sharing your midwifery expertise. Our particular thanks go to the women who completed the questionnaires.

Funding: The research was funded by a scholarship from the University of South Wales, UK. The funding source had no involvement in the development of this framework.

Conflicts of interest: None.

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